





AN ENTIRE
Body of Philosophy,
According to the
PRINCIPLES
Of the Famous
RENE DES CARTES,
In Three Books: *J. Houlton*

- I. The INSTITUTION, in X. Parts; 1. *Logick*. 2. *Natural Theology*. 3. *Dæmonology*, or of *Created Spirits*. 4. *General Physicks*, or *Natural Philosophy*, generally considered. 5. *Special Natural Philosophy*, of the *World* and *Heaven*. 6. The Four Great Bodies, *Earth*, *Water*, *Air* and *Fire*, and what have their rise from them; where, of *Metals* and *Meteors*. 7. Of *Living Things* in general, and in particular of *Plants* and *Animals*. 8. *Man*, in respect to his *Body*. 9. *Man*, as to his *Mind* or *Soul*. And, 10. *Ethicks*, or *Moral Philosophy*, treating of *Man's* right Ordering his Life.
- II. The HISTORY of NATURE, which Illustrates the *Institution*, and consists of great Variety of *Experiments* relating thereto, and explained by the same *Principles*, in IX. Parts, 1. Of *Bodies*. 2. Of *Qualities*. 3. Of the *Earth* and *Heaven*. 4. Of the *Earth*, *Water*, *Fire* and *Air*. 5. Of *Things* dug out of the *Earth*. 6. Of *Meteors*. 7. Of *Plants*. 8. Of *Animals*. And, 9. Of *Man*.
- III. A Dissertation of the Want of SENSE and KNOWLEDGE in BRUTE ANIMALS, in II. Parts, giving a *Mechanical Account* of their Operations.

Written Originally in Latin by the Learned
ANTHONY LE GRAND.

Now carefully Translated from the last Corrections, Alterations, and large Additions of the Author, never yet Published.

The Whole WORK Illustrated with almost an Hundred
SCULPTURES
Dispersed to such places as best admit thereof: All designed, Drawn and Engraven *Historically* by good Artists. Besides the FIGURES or SCHEMES for the Explanation of the *Philosophical Parts* that require the same.
Endeavoured to be so done, that it may be of Use and Delight to the Ingenious of both Sexes.

By RICHARD BLOME.

L O N D O N:

Printed by Samuel Roycroft, and Sold by the Undertaker Richard Blome, dwelling in New Weld-street, at the Green Pales, near Clare-Market, MDCXCIV.

1694

TO THE

Right Honourable, and Truly Noble,

H E N R Y

Lord Viscount Sydney of Shepey,

Baron Milton, Lord Lieutenant of Kent, Constable of Dover Castle, Lord Warden of the Cinque Ports, Master General of Their Majesties Ordnance, Colonel of Their Majesties First Regiment of Foot Guards, one of the Gentlemen of His Majesties Bedchamber, and one of the Lords of Their Majesties Most Honourable Privy Council, &c.

My Lord,

I Am not unsensible that some part of the World, when they shall see your Lordships Name affixt to this Book, will be apt to say, That my inducements for laying it at your Honours Feet, are those generally made use of by Authors; to wit, the necessity of an Illustrious Patronage to defend the Work against the assaults of Envy and Ignorance: But I must beg leave to assure your Lordship and the World, that the true Reason for this my Dedication, ariseth from a well-grounded Belief, and the general concurrence of the Learned Part of this Nation, that your Honour is the properest Person to patronise a Work of this Nature, having by all the Actions of your Admired Life fully convinced the World, that you only are the absolute Master of the whole Body of PHILOSOPHY; and I my self have ever held it as a reasonable Position, That the Works of the Learned, like the Actions of the Noble, ought only to be judged by their Peers; nor can I think your Lordship, or any Learned Person will say, that a virtuous desire of Knowledge (and such I humbly conceive is Philosophy) needs or wants a Protection from any, since 'tis an experienced Truth, That Virtue carries her own Safeguard, as well as her own Reward.

But as to the Subject Matter of this Book, and the method of handling it, I shall not say any thing, but refer your Lordship to the Book it self, of which your Honour is so great a Judge; having in my memory, the admonition of Apelles to Alexander the Great, speaking improperly of the Noble Art of Painting; In things you understand not, says that Great Artist, be alwaies silent, lest by speaking, you betray a want

A

of

The Dedication.

of Judgment. But as for the Designing and Engraving the SCULPTURES which Imbellishes this Work, things more properly mine, than any other part of the Book, and in which through Practice and Experience I may be allowed to have some knowledge; I must beg leave to assure your Lordship, that they are, if not accurately, at least elaborately done; and had I not been therein concern'd, might have ventured to have said, they are the best ever made publick in this Nature and Nation. And if they be so happy as to contribute in the least to your Honours Satisfaction, or Entertainment, I shall thereby be abundantly rewarded for all my Care, Charge and Trouble, for the very White at which I aimed, both in publishing this Book, and writing this Epistle, was to have it in my power to declare to your Lordship, that the ultimate of my Ambition is to serve you whilst I Live, and when Dead, to be recommended to Posterity under this desirable Character, That I had the happiness to be known to your Honour, who is allowed by all the Judicious, to be the Glory of the Age you live in, and to excel all that have gone before you, and to stand a Great, Noble, and hardly to be pattern'd Example to those that shall succeed. And of You, most Noble Sir, 'tis with more Truth than Complement said, that HENRY Lord SYDNEY doth abundantly surpass both in Wisdom and Heroick Performances, the so much famed Sir PHILIP SYDNEY (whom, the Age he lived in, thought worthy to be a King) and that in times to come they will mention his Alliance to you, to aggrandize his Character. Nor are these, my Lord, half the Hecatombs of Praise offered up to your great Merit, by the grateful and understanding part of Mankind; nor one third of what I might justly say: But such is your Lordships great Modesty, to be equalled by nothing but your Courage, that you always decline hearing a recital of your Illustrious Actions, tho' you never omit any opportunity of performing them: And therefore I shall only beg leave to tell your Honour, with all due Deference to your Exalted Station; that there is no part of the World which You have graced with Your Presence, and obliged with Your Goodness, is, or can be more truly sensible of what they owe You, or more willing entirely to sacrifice their All to your Lordships Service, than the Publisher of this Work; who is, may it please your Honour, with the most profound Respect imaginable,

My Lord,

Your Honours

most Obligated, and most Humble Servant,

Richard Blome.

T H E

T H E
E P I S T L E
T O T H E
R E A D E R.

BY my indefatigable *Labour* for these twenty Years, I have employed my time, with no small *Expences* in the *Printing* of several *Volumes*, not only *Useful*, but *Honourable* to this *Nation*, which have met with a kind Reception from the *Nobility* and *Gentry*, some of which I shall here give the *Reader* a short account of, as having a small quantity of each remaining, which the *Curious* may be accommodated with. And this their *Encouragement* has emboldned me to undertake this Great Work in *English*, which of all *Subjects*, is the most wanting; and the rather, because appearing in our *Native Tongue*, 'tis thereby more useful for the *Publick Good*, and of more universal *Benefit*. For it seems a kind of *Illnatur'd Retrenchment* upon the common *Freedom* of *Mankind* to lock up all *Ingenious Arts* and *Sciences* from them, unless they are *Masters* of a *Greek* or *Latin Key* to open 'em. The *Travel* into *PHILOSOPHY* and true *Wisdom*, like the *Commerce* into the *Rich Indies*, should be declared *Free*, and of equal *Right* to all the *Subjects* of *England*, without incurring the *Premunire* of *Interlopers*.

Tongues and *Languages*, I confess are a fine and sumptuous *Portico*; but then they are no more than a *Portico*. The *Sciences* to which they introduce, are the *Main Mafs* and *Body* of true *Learning*; and 'tis somewhat of the hardest, that so fair a *Pile* should have that only *Gate* to enter at: Besides, not to instance how many, otherwise very ingenious *Men*, are hereby debarr'd the *Study* of *Wisdom* and *Virtue*, whilst couch'd only in a *Language*, which possibly their *Education*, or want of *Leisure* has not made them *Masters* of: Here's a perfect *Turkish* piece of *Cruelty*; for we thus make *Learning* an absolute *Mahometan Mosque*, whilst the whole *Fair Sex* are at once excluded from any part of their *Devotion* in it. And let me tell you, the most complaisant *French Authors* generally *Print* their *Philosophical Books* in their own *Language*, by which the *French Ladies*, to the *Glory* of their *Sex*, have arrived to a great perfection of *Knowledge*; in which extraordinary *Accomplishments*, being able to *discourse* of the *Heavens*, the *Motion* of the *Planets*, and the *Nature* and *Causes* of *Mundane Things*, &c. beside the *Improvement* of *Virtue*, they have elevated their *Conversation* above the *Common Rate* of *Feminine Eloquence*, such as their descant upon *Commodities*, *New Fashions*, or the little *Vanities*, and have added no little *Charm* and *Grace* to many *Profect Virtuoso's*. And truly tho' we have at present set up our *Standard* against *France*, yet I could wish we might still continue one piece of *Friendship*, viz. our old *Custom* of following the *Mode* of *France*, in bringing that one *French Fashion* up, of making our *Learning* speak *English* to instruct both ours, and the *Fair Sex*.

And altho' this *Volume* of *PHILOSOPHY* has been so well received in *Latin* by the *Sale* of several *Impressions*; yet for the making it more exact and perfect, I contracted with the *Author* *Mr. Le Grand* to make *Additions* thereunto; so that by his large *Additions* and great *Alterations* throughout, it may be boldly said to be a *New Book*, and the best yet extant in any *Language*.

My

The Epistle.

My next business was to employ an able *Translator* and *Supervisor*, which with the care of the said Mr. *Le Grand*, every thing throughout is rendered so facile, and adapted to the *English Dress*, as to be of *Use* and *Delight* to all *Persons*. I have also *Engraven* the *SCHEMES* or *FIGURES* that were formerly in *Wood*, now on *Copper*: And for the adornment of the said *WORK*, have *illustrated* it with above 90 *SCULPTURES*, *Historically* and *Poetically Designed*, and *Engraven* by good *Artists*, relating to the several *Subjects* that best admit thereof: And have added an *Explanatory INDEX* or *TABLE* of the several *SCULPTURES*, that the *Reader* may the better know the meaning thereof.

The *SCHEMES* or *FIGURES* are *Engraven* on three *Copper Plates*, two for those in the *Institution*, and one for those in the *History of Nature*, all numbred 1, 2, 3, 4, and so on as in the *Plates*, with reference to the *Book* by the *Folio*, and the said number in the *Margent*; which said *Plates* of *Schemes* are to be placed at the beginning of the *Book* next the *Preface* of Mr. *Le Grand*, which gives you an account of the *Work*, and the *Arms* of the *Benefactors* to follow the *Schemes*.

Richard Blome.

An Account of some Volumes which the Curious may be accommodated with by me.

The *Gentleman's Recreation*, in Two Parts, in large Folio. The first, of the *Liberal* and *Mathematical Sciences*; which in a brief and clear Method treats of the *Doctrin* and *General Parts* of each *Art*, with *Elipsical Tables* engraven on *Copper Plates*, for the better comprehending the same. The Second Part at large treats of *Horsemanship*, *Hawking*, *Hunting*, *Fowling*, *Fishing* and *Agriculture*; all being Collected from the most Authentick *Authors*, and the many gross Errors therein Corrected, with great *Enlargements* made by those well Experienced therein. And for the better Explanation thereof great variety of useful *Sculptures*, as *Nets*, *Engins*, *Traps*, &c. are added, for the taking of *Beasts*, *Fowl* and *Fish*, not published by any: Nothing material being omitted for the rendering them Compleat. The whole Illustrated with about 86 Ornamental *Copper Plates*; in Folio.

The *History* of the *Old* and *New Testament*, treating of the most remarkable *Transactions* therein, with good and useful *Morals*, for the better government of our *Actions* in all *Conditions*. To which is added, the *Travels*, *Voyages* and *Lives* of the *Apostles*; with a large *Historical Chronology* of such Matters of Note that are related in the *Bible*: Collected and Translated by good *Hands*, from Authentick *Authors*. The whole Illustrated with about 240 *Sculptures*, of the most remarkable *Passages*, performed by good *Artists*, far surpassing any *Collection* hitherto done, to the end it may be the more acceptable to the *Curious*. This *Work* is Printed in Two *Volumes* in large Folio, of a fair Print, and chiefly designed for the *Curious*.

The said *Work* is likewise Printed in large *Octavo*, with all the *Sculptures*, as designed for a more general Sale, for *Youth*, to instruct them in the *Historical* parts of the *Bible*: *Sculptures* being lively *Emblems*, to imprint the same in their *Memories*.

A useful *Volume* of *Cosmography* and *Geography*, in Two Parts, in Folio. The First, of the *Arts* of *Cosmography* and *Geography*, being a *Translation* of the much Esteemed *VARENIUS*. The Second Part is a *Geographical Description* of the *World*, from the *Works* of the Famous Monsieur *SANSON*; with about a 100 *Geographical Tables* of the *Kingdoms* and *Isles* in the *World*, with their Chief *Places*, drawn from the *Maps* of the several *Kingdoms*, which illustrates this *Work*. And to this *Impression* are added the *County Maps* of *England*, drawn from those of *Speed's* in a smaller *Scale*.

T H E

THE P R E F A C E.

SECTION I.

Of the Nature, Principles, Object, Use, Rise and Progress of PHILOSOPHY.

PHILOSOPHY, according to its Etymology, is the love and study of Wisdom; where by Wisdom we understand such a disposition of the Mind, by which Man is firmly inclined to have right Sentiments of the Things that occur to his perception, and to make a just Examination of the Actions that belong to his Life. For Wisdom doth not only direct the Understanding, and guide the Mind in the Contemplation of Truth; but also inclines it to Honesty, and assists the Will in the prosecution of Vertue: So that Wisdom is indeed nothing else but a perfect Knowledge of all those things which it is possible for Man to know, and which may be both a Rule to his Life, and a Help to the Inventing of all Arts whatsoever.

Whence PHILOSOPHY may be defined a Habit of the Mind, acquired by Study and Exercise from Inborn Ideas and self evident Principles, enlightning the Understanding into the knowledge of necessary things, and perfecting the Will by Honest and Vertuous Actions.

Now to the end this Science may have these Effects, it is necessary that it be deduced from first Causes; so that whosoever desires to be Master of it, must begin with an enquiry into these Causes: Because this is the first property of the Principles of Things, to be so clear and evident as not to stand in need of any proof of their Certainty, and to be raised beyond the reach of Doubting; so that whosoever minds them, can't doubt of their Truth. Secondly, They are such on which other things depend, and without the knowledge whereof nothing of Certainty can be had. Wherefore tho' the first Causes of Things may be known, tho' the Things themselves be unknown; yet it is impossible, but that when these are known, those must be likewise known; because the Truth of these depends on the evidence of their first Causes. And accordingly whatsoever is demonstrated concerning them, without a self-evident Principle must needs be dark and uncertain. For as DESCARTES saith; No Conclusions deduced from an unevident Principle, can be evident, tho' they should be deduced thence with the greatest Evidence imaginable.

It is not only one Genus, or general Head of things, that is the Object of PHILOSOPHY; but she extends her self to all things which the Mind of Man is capable of knowing. And therefore Plato, as Ammonius tells us, called it The knowledge of things Human and Divine; forasmuch as it doth not only consider Corporal Things, but also contemplates the Supream Cause and Intelligences void of Matter, and enquires into their Attributes and Perfections. For this is it (saith Cicero) which dispels all dimness from the Eye of the Soul, and enableth us to see all things, whether Superior or Inferior, first, last, or middlemost.

From whence we may gather the true Use of PHILOSOPHY, and how many Advantages it affords us. For, first it helps the Soul to condemn those Transitory and Temporal things, to which from its Childhood it has been too much addicted, and raises its desires to things Heavenly and Eternal. Secondly, It assists us in the thorough search into our own Natures, in the knowledge of our Creator, and the attentive Consideration of his Works. Thirdly, Whilst it evidenceth Truth to us by clear and indubitable Demonstrations, it affords us extraordinary pleasure and delight, as displaying those things in a full light to us, which are hid from the greatest part of Mankind. Fourthly, It removes Wonder, which ever is the Companion of Ignorance, and gives us a clear Light, whereby to discern Great things from Small, and to esteem things according to their true Value. Fifthly, By the Exercise hereof we are prepared to know the several Objects we meet with more distinctly, and to judge of them with more Caution and Exactness; for by the long continued Study of Philosophy we become more prudent and cautious in passing Sentence concerning things.

What PHILOSOPHY is.

How it is defined.

Of what kind the Principles of Philosophy are to be.

What is the Object of Philosophy.

What is the Use of Philosophy.

The P R E F A C E.

Whence Philo-
sophy had its
rise.

PYTHAGORAS was the first amongst the Ancients who assumed the Name of Philosopher, by way of Modesty, as condemning the Pride and Arrogance of others who would be called Sophi, that is, Wise Men. For this discreet Person was so sensible of our Ignorance, that he thought that that Title did befeem God alone, and could not deservedly be given to any Mortal. But because the Original of Wisdom and Philosophy is one and the same, which was many Ages before Pythagoras, we must look for it long before his time: Which if we do, we shall find that it could not proceed from any one else but God, the Father of Lights, from whom every perfect Good comes, and the Truth of all things is derived. Hence it is the Poets tell us, That Pallas or Minerva, the Goddess of Wisdom, was the birth of Jupiter's Brain; intimating thereby that all Knowledge comes from GOD, and takes its rise from his Understanding. For it is certain that Adam, the first of Mankind, was a wise Man, soasmuch as he gave Names to Things, and taught his Sons the knowledge of the Stars, which he could never have done, if he had not been endued with Wisdom, and understood the Nature and Property of Things.

How Philoso-
phy has been
transmitted to
us from Adam.

It is probable that this most excellent Gift of God, was handed from Adam by Methusalem to Noah, and from him, his Sons and Grandchildren, to the Chaldeans and Hebrews, who were famous for their Knowledge of many things, and from them to the Egyptians; from the Egyptians to the Grecians, and from them to the Romans; from whom, in process of time, the same was derived to the Northern and Western Nations.

How some
think it had
its rise accord-
ing to the Na-
ture or scitua-
tion of Coun-
tries.

Some that begin not the Pedigree of **PHILOSOPHY** so high as we do, tell us, That it had its rise according to the Nature or Scituation of the Countries where those lived who had the first Knowledge of it: Necessity, which is usually the first Mistress of Sciences, having taught them what were proper for their Needs. 'Twas thus, say they, that the **EGYPTIANS** began to observe the Increase and Decrease of the Nile, and to make every Tear a Prognostick of the Fruitfulness or Sterility of their Lands. And to part, with the more facility their Harvest, among those particular Persons who were to have their Shares thereof, they learnt the first Principles of Geometry. The **ASSYRIANS**, who inhabited vast and unclouded Countries, having nothing to hinder them from contemplating the Stars, were the first that observed their Motion; and the **CHALDEANS**, who were amongst these People a kind of Philosophers, found from this Speculation an Art of Foretelling things to come. In fine, The **PHÆNICIANS**, who were Neighbours to the Sea, drew another Benefit from the Knowledge of the Stars, and addicted themselves to observe those which might be useful to Navigation; in which they succeeded so well, that they found out that there was a fixed Point towards the Pole, the observation of which might be a Guide to Pilots.

SECTION II.

The Chief and most Celebrated PHILOSOPHERS.

THALES.

Amongst those who are most Celebrated for Philosophy, **THALES** the Milesian, so called from Milerus the Capital City of Ionia, in which 'tis said he was born, 639 years before Christ, is accounted the first. He was a great Astronomer, and the first that observed the Solstices and Equinoxes. His Opinion was, That Water was the Principle of all Things.

**ANAXIMAN-
DER.**

The Successor of Thales was **ANAXIMANDER**, who was also Born at Milerus, and the first Founder of the Ionick Sect. He distinguished the Four Elements, placed the Earth in the Center, and by the scituation he gave them, was the first that erected a kind of System of the World. Strabo and Laertius assure us, that he was the first also that made Maps. He never determined, as Thales, which of the Elements was the Principle of Natural things, but concluded it to be Immenfc.

**ANAXIMIN-
ES.
ANAXAGO-
RAS.
ARCHELAUS.
HERACLITUS.
DEMOCRITUS**

ANAXIMINES followed Anaximander, being also Born in the same City. He owned Infinite Air to be the Principle of all Things. His Disciple was **ANAXAGORAS** of Clazomene, who was the first that brought Philosophy from Ionia to Athens. He declared Matter and Spirit to be the first Principles; that at the Beginning all Things were in Confusion, and that it was the Spirit that separated, distinguished and establisht them in that beautiful Order wherein we see them. Anaxagoras his Scholar was **ARCHELAUS** the Athenian, who was the Assertor of Similar Parts, and held Heat and Cold to be the Principles of all Things. To these also may be added, **HERACLITUS** the Athenian, who maintained that the first Principle was Fire: And **DEMOCRITUS** the Abderite, who would have it to be Atoms. These were of the Ionick Sect.

**PYTHAGO-
RAS.**

PYTHAGORAS of Samos, flourished in the Year 571 before Christ, and was the first that Instituted the Italick Sect in that part of Italy commonly called Great Greece, now Calabria. He took a different course from his Predecessors, vailing his Natural and Divine Philosophy under the



G. Fréman. Inv.

Philosophers

J. Kip. Scul.

To the Right Noble Frances
Dowager of the High borne
of Richmond and Lenox,
Darnley, Baron of Leighton,
and Methuen; Hereditary
L^d. High Admirall of Scotland, &c.
of Spaine and Knight of the
This Plate is humbly



Teresa Stuart, Dutches
Prince Charles Stuart Duke
Earle of March, Litchfield, &
Bromsvold, Newbury, Torbolton,
L^d. High Chamberlaine, and
L^d. of Aubigny in France, &c. and
most Noble Order of the Garter &c.
Dedicated by Richard Blome



The P R E F A C E.

the secret Science of Numbers, and was full of Symbolical and Figurative Expressions; being persuaded that it was to profane the Truth, to expose it naked to the Eyes of the People. His Disciples were not permitted to speak of the Mysteries he taught them, till after five Years continual Silence. It was his Fundamental Maxim, that Unity was the Principle of the Generation of all Things, and that Plurality was the Corruption of them. To these Numbers he added a certain Harmony, by which he explained the Perfection of all Things. Vertue (according to him) Health, the Soul, and God himself is nothing but an Harmony, and there is nothing more known than the Harmony which this Philosopher imagin'd to Rule the Celestial Orbs. He held the Transmigration of Souls, discovered the Qualities of each Element, the figure of their Bodies, the roundness of the Earth, and the Antipodes. He distinguished the Seasons, observed the different Course the Sun makes daily and yearly, and how the Moon receives her Light from it.

SOCRATES, who was Born at Athens 468 years before Christ, leaving the Study of Natural Philosophy, wholly addicted himself to Ethicks. Accordingly Tully, in the Third Book of his Tusculan Questions, tells us, That all that Philosophy which undertakes the Conduct of Life and Manners, was derived from Socrates; and therefore saith, That he had called down Philosophy from Heaven, to take up its abode in Cities and Houses. SOCRATES.

PLATO, an Athenian, was born in the year 427 before Christ, and for his extraordinary Learning and wonderful Sagacity in the searching out of Truth, had the Name of the Divine Philosopher bestowed upon him. His School set about with Trees was in the Suburbs of Athens, first called Ecademia, from one Ecademus the Possessor of it, and afterwards Academia, which gave the Name to his Sect. He concluded God, Idea and Matter, to be the Principles of all Things. Concerning his Opinion of these Idea's, the Learned are much divided. Some would have him hold that they are Eternal Substances, Forms existing from themselves, and distinct from the Knowledge of God, as Models quite separated from him, and such as upon which he forms the Ground of his Work. But others are of another Judgment, declaring that in his Doctrin the Idea of the World is no other thing than the Image the Creator has formed. As for Matter, he suppos'd it to be void of all Form, and that before the Creation of the World it was a kind of Chaos, yet capable of all Forms: And forasmuch as it hath a Disposition whereby it may be distinguished into divers Bodies, which disposition he makes to be nothing else than a Pyramidal, Cubical, or other kind of Figuration, of the least and invisible Particles of which the Elements are compounded; He consequently asserts, that Pyramidal volatile Particles constitute Fire; that Cubical and subfiding Particles make Earth; Octahedrical or Eight corner'd, Air; and Eicosahedrical or Twenty corner'd, Water. PLATO.

ARISTOTLE, the Son of Nichomachus, Born at Stagyræ in Macedonia 383 years before the Birth of Christ, differed much in his Sentiments of Philosophy from his Master Plato, who therefore compared him to a Colt kicking his own Dam. He had the Liceum for his School, a House near Athens, which had been Apollo's Temple, built by a certain one called Licus. Here his Disciples Disputed Walking, from whence that place, according to the Greek word for it, was called **PIRAPATOS**, and they themselves **PERIPATETICKS**. This Philosopher became Famous by being the Præceptor of Alexander the Great, as well as by his sharp Wit, and the great number of his Writings. He held Matter, Form and Privation to be the Principles of all Natural Beings. ARISTOTLE.

ARCESILAUS of Sardis in Lydia, flourish'd in the Year 297 before Christ, and Taught at Athens, where he was the Author of a Sect called in after Times the Middle Academy, to distinguish it from the Old Academy, which begun with Plato; and from the New, which was instituted by Lacides of Cyrene, as will be presently declared. He asserted that there was no Certainty, but only a bare Probability in the Knowledge of Things; so that he thought we might equally hold Pro and Con upon all Subjects, and therefore would never determine, but always suspended his Judgment. ARCESILAUS.

LACIDES the Cyrenean, newly mention'd, Taught in the same School some years after Arcefilaus, and was the Head (as I said) of the Sect which was called the New Academy. He acknowledged that something was highly probable, at least that one thing was more probable than another, and accordingly determin'd; but was not sure that anything was absolutely True. LACIDES.

PIRRHO of Elæa, was also the Founder of a New Sect, that is, a New manner of Philosophizing; for he had no Dogma's at all, as believing that nothing was true or likely, that is, so much as probable. He went beyond the Academicians: For whereas they comprehended, that Nothing could be comprehended, he did not comprehend that. His Followers were called **EPHECTICI**, from their withholding their Assents: **SCEPTICI**, from their Considering and Canvassing: **ZETETICI**, or Seekers, from their Search and Enquiry: And **APOZETICI**, from the continual Doubts and Difficulties they were used to object to the Dogmatical Philosophers. PIRRHO.

The P R E F A C E.

Z E N O.

Z E N O the Citian had his School at Athens in a Painted Gallery called Stoa, whence his Disciples had the name of Stoicks. Vertue was the Sovereign Good in his Morals, and he is famous for that Constancy he inspired into his Followers in the extremity of Affairs. They would never confess Pain to be an Evil. He held the first Matter to be destitute of all Qualities, as of Heat, Cold, &c. as also without any Form, Shape, or Figure. He supposed that besides the World, there was a certain infinite Space altogether void and empty, in which the World after its Conflagration might be resolved. He asserted two Principles, viz. God and Matter, without which nothing could subsist.

E P I C U R U S.

E P I C U R U S was Born at Athens 257 years before Christ. He kept his School in some Gardens in that City, and was the Author of a peculiar Sect. He Taught, as well as Z E N O, the love of Vertue; but that only for the Pleasure of it, and in that Pleasure he comprehends that of Sense, as well as that of the Soul; maintaining, That a Wise Man could not be happy, if he enjoyed not all Pleasures Mankind was capable of. In this he did not so well explain himself, but that he gave occasion of raising Doubts concerning his true Conceptions; some believing them to be Innocent, whilst others, and those the most numerous, think otherwise; in so much that the Epicureans are now generally look'd upon as too Sensual. The rest of his Morals, concerning God, Providence, and the Soul, are also much blamed. He took from D E M O - C R I T U S the Principle of his Physick, adding thereto the declension of Atoms, with a motion of Weight. His Opinions were, That nothing was without Beginning or End, but Atoms and empty Space: That the Universe always abides unchangeable in the Whole, tho' as to its Parts it be variously altered. He endeavours to prove the necessity of an Empty Space from Motion, and asserts, that the World shall some time or other be dissolved by the force of Nature.

G A S S E N D U S.

The Famous P E T R U S G A S S E N D U S, Mathematick Professor in the University of Paris, Born in Anno 1592, hath endeavoured to Amend and Perfect the Epicurean Philosophy, especially by refuting its Errors concerning God, Providence, the Souls Immortality, &c. and by a cautious Explication of such of his Opinions in Natural Philosophy, which tho' not utterly condemned, yet not being sufficiently proved, but Doubtful and Slippery, might be an occasion of falling into Error.

D E S C A R T E S.

After all these was Born R E N A T U S D E S C A R T E S, at la Haye in France, of a Noble and Ancient Family, in the year of our Lord 1597, who by a Method, before his Time but imperfectly known, restored Philosophy from the very Foundations, opening a sure and solid Way to Mankind into the inmost Recesses of Nature. He was of such a singular Genius, that he alone discovered more Philosophical Truths, than ever were discovered in all foregoing Ages. We do not go about here to give any Instances of his Philosophical Sentiments, since this whole Work contains nothing else, but his Opinions, or what may clearly and distinctly be deduced from them.

S E C T I O N III.

The Parts of *PHILOSOPHY*, and the Design of this whole Work.

Of the Parts
of *PHILOSOPHY*.

P*HILOSOPHY is commonly divided into Three Parts, viz. First, Into METAPHYSICKS, or NATURAL THEOLOGY, which proves the Being of a God, or First Cause, on whose existence all Truths depend, and without the knowledge of whom no Science can be had. Secondly, Into PHYSIOLOGY, or NATURAL PHILOSOPHY, which comprehends the Principles of Material Things, considers the Original of the World, and enquires into the Parts whereof it doth consist; and afterwards descends to consider the Form, and Qualifications of the Sun, Stars and Planets; the force and vertue of the Air, Water, Fire, Fossils, or things dug out of the Earth, as Metals, &c. And lastly, Enquires into the Nature of Plants and Animals, and more especially of Man, who is a Compendium of the Universe; and lastly into MORAL PHILOSOPHY, or ETHICKS, which searches into the Nature of Good; discovers what Manners are honest and becoming, and directs and governs all our voluntary Actions, according to the Rule of Right Reason. But to the end that in the handling of Philosophy the Modus (that is, the Natural Way and Order) of Science may be observed, I have rather thought fit to distinguish Philosophy into Ten Parts, that by this Division my Discourse might be more Methodical, and avoid the Confusion which is incident to the former Partition.*

LOGICK,
the First Part
of Philosophy.

I thought fit therefore to make LOGICK the First Part of my Discourse, it being the Organ or Instrument of all PHILOSOPHY, and very necessary to the attaining of all Sciences. Because I never esteemed any thing more valuable in Man, than a good Mind or Under-

The P R E F A C E.

Understanding, whereby he is enabled to unfold the Natures of Things, and to discern Truth from Falshood. For all other Gifts of the Mind have their Bounds, and are only determin'd to some particular Offices: But the Rectitude of the Understanding is conducive to all the Uses of Life; and is not only profitable in the dispatch of Business, but for the attaining of Arts and Sciences. For this Reason it is that I have begun this Philosophical Treatise with LOGICK, which is the Art that Teaches the right use of Reason, and how Man ought to manage his Thoughts in the knowing and judging of Things. And forasmuch as the Mind of Man is subject to many Errors, and is biast for those Opinions it has embrac'd during Childhood, having premised something of the Usefulness of LOGICK, I take occasion to advise every one carefully to avoid the Prejudices of Infancy, and not to admit any thing for Truth, but what clear and distinct Perception hath manifested to be such. For he judgeth wrong who doth not give heed to his Conceptions, and compriseth more in the Conclusion, than he had perceived in the Premisses.

For the avoiding of this Præcipitancy, I first examin the simple Terms of Things, and briefly enumerate those Notions of which our Thoughts are compounded; afterwards I set down a Scheme of Substance, and its Attributes, by which it is more distinctly understood and distinguished from the Modes that belong to it. To this end it will be of great use attentively to consider the Genealogy of Things and Modes; as also the Imposition, Signification, Definition and Use of Names. But because it is not sufficient to have Idea's of Things, except we know also whether they be simple, or resolvable into other Parts: I have added the Chapter of Definition and Division, by which means all Confusion may be removed, and the Nature of every thing, and its distinction from others more clearly known.

After the clear Perception of Things, I come to the Judgment we are to make of every Thing; and in so doing, I proceed from simple Things to those that are Compound, and as it were from the first Step of Logick to the second. The Sum whereof is this, That in our search of Truth, we never give our Assent to any thing which doth not exactly answer to our Perception: For it is not enough that Truth be in this or the other thing, except the same do appear to us, and we be fully convinc'd of its Certainty. For I take him to know nothing at all, who relies only upon the Authority of others, and is led by their Judgment, without hearkning to his own.

After this, I proceed to the Explication of a Syllogism, which is made up of divers Judgments that are found of them. Now whether Syllogisms are of so great use towards the acquiring of Sciences, as in the Schools they are boasted to be, I dare not assert, seeing that the greatest part of those Errors Men fall into are much more caused by their using of false Principles, than by their not observing the Rules of Good Reasoning. However, they must be acknowledged to have their Use, as being very helpful for the exercise of Wit, and more especially for those, who through overmuch Subtilty, or want of due Attention, suffer themselves to be deceived by false Consequences, and to be led into Error.

That which concludes this Part of PHILOSOPHY, is METHOD, which is the chiefest Part of Logick, and without all Controversie the most useful. For it being that Judgment of the Mind, by means of which whatsoever belongs to a whole Science is fitly and rightly disposed and digested; it is extremely conducive to the discovering any Truths we are ignorant of, or to the convincing of others of those we know already. This Method in particular is either Genetical or Analytical, in both which the true Practice of Logick is perfected.

But forasmuch as all our Knowledge is uncertain, as long as the most perfect Being, from whom all others do proceed, is not known to exist; therefore I begin the Second Part of this Treatise with the Existence of GOD. This I evince from the Idea we have of him which represents a Being absolutely perfect, wise, and powerful. For 'tis a Contradiction, that that which includes all Perfection should not be necessarily Existent, seeing that Existence is a vov'd Perfection, which therefore can't be absent from a Being absolutely Perfect. And therefore as we clearly understand, that in the Idea of a Triangle is contain'd, that its three Angles are equal to two right ones; so we find, that in the Conception of GOD is involved Necessary and Eternal Existence. From hence we duly infer, that GOD is the Creator of all things, not only in respect of their Existence, but also of their Essence: So that even the Propositions of Eternal Truth do depend on this first Truth, and are no farther True than as they are determined thereby. The Existence of GOD being demonstrated à priori, I proceed to lay open his Attributes, which by necessary consequence follow from it; since it is impossible but the supream Being must include Unity, Eternity, Omnipotence, Immensity, Beneficence, Providence, &c.

Having thus examined the Nature of GOD, and inquired into his Perfections according to the measure of our weak Understanding, the next in order to be considered, are the INTELLIGENCES and DÆMONS, whose Existence, as far as it can be reached by Natural Light, I have endeavour'd to demonstrate: And afterwards proceeding to their Faculties, have shew'd them

The Second
Part, is of
GOD.

The Third
Part; Of
Intelligences
and Demons.

The P R E F A C E:

them to be endowed with Understanding and Will: And because there is no small Dispute betwixt our Divines and the Talmudists, concerning their Number, Distinction and Subordination, I have barely set down their Opinions without adding any thing of my own. Thence I pass to the Power they have to assume Bodies; and add something concerning the Care and Concern they have for Mankind, which I briefly confirm from Texts of Scripture and Reasons deduced from their Natures.

The Fourth Part; Of Natural Philosophy in general.

It being proved that there is a GOD, by whose Power the Angels and all Things are produc'd, and that it is repugnant to his Nature to deceive us: We are sure that we can't be mistaken in those things which are clearly and distinctly known by us; and therefore seeing we have clear and distinct Idea's of Bodily Things, which we are not the Causes of, as being often represented to us whether we will or no; I thence infer, they must needs proceed from Objects without us, which really and actually exist in the World. For otherwise, if GOD should immediately impress such Idea's on our Minds, or cause them to be convey'd from Objects in which there was nothing of Extension, Motion, or Figure, it would follow that he did impose upon us; and therefore we must conclude, that there is a Substance extended in length, breadth and depth, or thickness, which we call Body, and is the Object of this Fourth Part. For all things that are handled in Physiology belong to Body, as its Forms or Affections.

Let not any one wonder that I exclude all substantial Forms from a Body, or extended Matter, since they are so obscure that they can't be explain'd, no nor so much as conceived by those very Men who are the great Patrons of them. Whereas on the other hand, nothing is more obvious and agreeable to our Senses, than to assign the Effects of Nature to the different Magnitude, Figure, Position, Motion, and the Rest of Bodies. Who is so stupid as not to apprehend these Principles? Is it not better to explain Things by Causes known and obvious to all, than to have recourse to some Principles, which none understand, and which are as dark and difficult to those that teach, as to those that learn them? It is folly to admit any thing in PHILOSOPHY which no Body could ever yet comprehend, no, nor I dare boldly say, ever will be comprehended.

If we admit that Material Substance consists in a Threefold Dimension, and that it can't be distinguished from Extension, save only by Reason or a Mental separation; it will be easie to demonstrate, that it is impossible for any Vacuum to be in Nature: That Rarefaction is only made by the intervening of New Matter: That the World is not circumscribed by any Bounds: That the Internal place of a Body, doth not at all differ from the Body it self; and that the Heavenly Matter is of the very same Nature with the Inferior and Sublunary. Forasmuch as that which the Philosophers call Quantity, is not the precise extension of the Body, but only its extension as such; that is, with respect to its being commensurate to such a number of Inches, Feet, Yards, &c. it being apparent that a Body retaining the self-same quantity, may be further extended in length and less in breadth, or on the contrary. As Matter hath some Essential properties, viz. Divisibility, Figure, Mensurability, and Impenetrability; so likewise it has some common Accidents, viz. Rarefaction, Local Motion, Heaviness, Lightness, Hardness, Softness, &c. which are not in it, as so many distinct things; but only as Modes, which can't be separated from the Body; and if they could, they would be no longer called Modes, but Substances, whose peculiar property it is to exist by themselves, and independent of any Subject. And seeing that as all the diversification of Matter, or the variety of its Forms, depends on Motion, by which the Matter is divided into Sensible and Insensible parts, I clearly make out, that the Three Elements of the World had their rise thence. Then having shewed that a Body hath no power to move it self, I make it appear, that all those Motions, which by the Peripateticks are commonly attributed to the prevention of a Vacuum, are occasioned, because all Motion of Bodies is in a manner circular, one succeeding in the place of another. Then I proceed to the determination of Motion, whether simple or compound, treat of Reflection and Refraction, of the Acting and Resisting power in Bodies, and wherein it consists. Afterwards of the state of Bodies, as to their Hardness, Fluidity, Rarity or Looseness of Parts, Closeness, Roughness and Smoothness, &c. where I shew, that there are Pores as well in fluid, as in hard Bodies; and last of all give a hint, that the Ends of GOD are not to be searched into in Physiology, because it is an Argument of Rashness and Arrogance. And as for TIME, under which we consider the Existence of Created things, it is improperly said to be an Affection belonging to them, since indeed it is a meer Mode of Thinking, serving only to explain Duration, and distinguish the Parts of it.

The Fifth Part; Of the World and Heaven.

Having thus laid those Foundations of NATURAL PHILOSOPHY, I proceed to consider the Unity and Perfection of the World, and endeavour first to shew, that the Creation of it may be discovered by Natural Reason: That its Extension is immense, or rather indetermin'd, so as not to be circumscribed by any Figure, or Bounds: That the Matter of Heavenly and Earthly Bodies is one and the same; and enquire at large what is the Form of the World, whether

The P R E F A C E.

whether it be the Soul, that is, the Spirit of Nature, or the best disposition of Parts: And in the next place assert, That GOD hath communicated to the Matter whereof the World is made, a determinate Measure of Motion, and doth preserve the same quantity in the same. Then pass on to examine the Action of Bodies, and the communication of Motion, and add some Rules by which we may know, what must of necessity happen in the meeting of Bodies. Then follow the Three noted Systems of the World, viz. The Ptolomaick, Tychonick, and Copernican, and after having rejected the two former, I with Descartes embrace the latter, as being more simple and better agreeing with the several Phænomena of the World. Then shewing the Heavens to be fluid, I go on to Evidence how they were disposed or rank'd at the beginning, and of what manner their Motions were, and what is the Action of the Heavenly Matter. And for a better understanding of the Celestial Motions, I define the Heavenly Globe with all its Circles, and their several Uses. Then examin the Nature of the Sun, the Adjuncts of Light and Luminosity. How Spots are generated about the Sun and the fix'd Stars, and vanish again. What Comets are, and how it comes to pass that fixed Stars are changed into Comets.

Next to the Comets are the Planets, whose rise is shewed, together with the Principle of their Motion, and how they become Direct, Retrograde, and Stationary. Then the Moons motion is considered, with its various Appearances, and the Eclipses of it, as well as of the Sun. Next follows the Nature of the fix'd Stars, their Number and Constellations, and concerning their Influences, as well as of the other Stars, and what Judgment we are to make of Judicial Astrology.

Having thus taken some Turns in the Heavens, we return again to the Earth, to take a more exact Account of its Original parts and Figure, and the manner of its being moved in the fluid Heaven; demonstrate also its Motion by Reason, and Answer the Objections made against it; and then discover all the Vicissitudes of Night and Day, and the several Seasons of the Year, which proceed from the Diurnal and Annual motion of the Earth. Then take notice of the Five Zones, invented by Geographers, to distinguish the Variety of Heat and Cold in the several Parts of the Earth, occasioned by the nearness or distance of the Sun; and the Climates made use of, for a more distinct Explication of the several Tracts and Regions of the Earth. Then proceed to the discovery of those Things which are generated in the Bowels of the Earth; as Fountains, Metals and Minerals, Stones, Gems, the Load-stone, and Electrical Bodies. After, speak of the Water, the Flux and Reflux of the Sea: Of the Air, and its Elastick virtue. Then of the Meteors in general, and particular; as of Winds, Clouds, Mists, Rain, Dew, Hoar-frost, Cool of the Evening, Snow, Hail, Thunder, Lightning, Coruscations, the Rain-Bow, Circles formed about Stars, and Mock-Suns. Then unfold the Nature of Fire, Heat and Cold: The most remarkable Effects of Fire, as the Effervescence of some Bodies, and the Turning of others into a Calx or Ashes, Earthquakes, Fermentation, &c. and last of all consider the Mixtion, Generation, Corruption, Alteration, Augmentation, and Diminution of Bodies.

Having thus largely enough handled (as I suppose) Inanimate things, I proceed to those that are Living, and having premised their Distinction from Things without Life, I assert their Life to consist in a due Temperament of Heat and Moisture, and consequently that their Death proceeds from the contrary Causes of Cold and Dryness. Next I enquire into the Cause of the Hardness which is observed in the Outside of them, and of the difference of this Vital Heat in Living Creatures, and why the same is weaker in some, and more strong and durable in others. Then discover the Nature and Virtue of the Aliment or Food wherewith Living Creatures are Nourished, and how Living Things come to be changed by the diversity of Place and Time; and then come down to Plants, and having explained their Parts, Original Nutrition, Growth, Difference and Propagation, I enquire into the Causes of their different Colour, Taste and Smell; as likewise of their Perishing or Death. Lastly, I lay open the Nature of Animals, what the Souls of Beasts are, and then examin in particular the Nature of Fourfooted Beasts, Creeping Things, Birds, Fish and Insects, and wherein the Death of these consists.

After having taken a View of this Great World, I proceed to the Consideration of the Lesser World MAN, who may be defined a Compound of a finite Mind, and rightly disposed Body. But forasmuch as these two Parts are wholly of a distinct Nature, without any Analogy between them, I thought fitting to consider them each apart, and handle them distinctly, that the several Proprieties of each might be the better known. Wherefore I set down the description of the most principal Parts of Mans Body, both Internal and External; give an Account of the Formation of the Birth in the Womb, and of its Animation; as likewise of Nutrition, the motion of the Heart, Arteries and Muscles, and of the Circulation of the Blood. Then follows Respiration, and how the same is performed in Man; and lastly, some things are added of the Increase and Decrease of Mans Body, its Temperaments, and different Ages. And forasmuch as the Senses do chiefly belong to Man, I treat first of the Senses in common, and shew that they are the Effect of the

The Sixth Part,
Concerning the
Four Bodies.

The Seventh
Part; Of Living
Creatures.

The Eighth
Part; Of
MAN.

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the Nerves, and that the Soul of Man feels only, forasmuch as it resides in the Brain: Then I speak of the Senses in particular, viz. of Feeling, Tasting, Smelling, Hearing, and lastly having said something concerning the Eye and its Object, I Discourse concerning Sight, the most Noble of all the Senses, and of the manner how it is performed, and shew how the Scituation, Distance, Magnitude and Figure of Bodies are thereby discerned; and then add some Chapters of Waking, Sleep and Dreams; the Appetite of Hunger and Thirst; of the Common Sense, Imagination and Memory; of Health and Sickneſs; and lastly, of Medicaments in general, and their Operation.

The Ninth
Part; Of the
Mind, or Soul
of Man.

I look upon the Rational Soul as the Chief Part of Man, which excelleth the Body in its Nature and Functions; I evince that the same is more evidently perceived by us than the Body, since we cannot doubt of its existence even at the very instant we are doubting of it: For it is a Thinking Being, not only potentially, as some conceive, but actually; because Thinking can't be separated from it without the destruction of its Nature; whence I Argue, that it is essentially distinct from Material things, which consist in extension, and consequently that it is Spiritual and Immortal. Now as to the manner of the Union of these two Substances in Man, I briefly assert, that the same consists in this, that the Functions of the Body depend on the Cogitations of the Mind, and they again on the Motions of the Body, which Miracle is the work of the All-wise and Omnipotent GOD alone, as the Immortality and Eternal duration of the Soul is the effect of his Good pleasure. I prove that there are inborn Idea's in the Mind of Man, especially of GOD, a Thing, Substance, general Maxims of Truth, Good, Equity, &c. and explain the four Faculties of the Mind of Man, viz. Understanding, Imagination, Will and Memory; not as Things really distinct from it, but only as so many Modes, whereby it Understands, Imagines, Wills and Remembers.

And because the Affections and Passions are the consequence of the close Union there is between the Soul and Body, I shall in the next place handle them, and endeavour to lay down in short their Nature, Causes and Effects; and tho' there be many of them, and according to the variety of their Objects, are called by several Names, yet they have all of them but one and the same common Principle, to wit, the Animal Spirits, by the Motion whereof they are produced and strengthened. For all of them (if we except Admiration) are conveyed to the Brain, and are always accompanied with a peculiar dilatation of the Blood. I enquire also in what part of the Body the Soul entertains its Passions; what Love is, what Hatred, what Joy, and what Sorrow. Lastly, I undertake to assign the Cause of those Inclinations which are peculiar to certain Persons, and to which some give the Names of Sympathy and Antipathy, which I deduce from those Motions, that by some external Cause are excited in the Body from its first Infancy, and are apt afterwards to awaken the same Thoughts in the Soul; as on the other hand likewise the same recurring Thoughts produce the same Motions in the Body.

The Tenth and
last Part;
Concerning
the right Con-
duct of Life.

Last of all, this PHILOSOPHY is concluded with a Discourse of the right ordering and guidance of Life, the Happiness whereof doth not consist in Bodily pleasures, the Goods of Fortune, or the Gifts of the Mind; but in a firm unshaken purpose and resolution of well-doing, and in the satisfaction which thence ariseth. And because no Body can be said to do well, but he that acts according to Vertue, I proceed to the Explication of VERTUE in general, and unfold its Essence, shewing that it doth not consist in a Mean of the Affections, but in a constant pursuit of what seems best to Right Reason; and then pass on to the several Species of it, viz. Prudence, Temperance, Fortitude and Justice, which are so many Foundations of Human Happiness. I have not thought it any Crime in the handling of them, to depart from the received Custom of the Schools, and to Exhort my Readers rather to Doing than Talking, as knowing that Vertues are not acquired by Questions or Divisions, but by Precepts or Rules for the Forming of our Manners. I have also added some Articles concerning the use of the Passions, which I conceive to be of no small Advantage to the obtaining of Human Felicity, as long as they continue under the Guidance of Reason, and without Transgressing any of its Laws. And forasmuch as all Vertue would be in vain, in case Man were deprived of Free-will, I endeavour to prove, that Man was created Free by God, and that his Præscience and Power, is no hindrance to Human Liberty, and that notwithstanding the same, a Man may exert Actions worthy of praise or reproach.

But because these ETHICKS might appear defective without saying something concerning Human Actions, I thought fit to add a few things concerning the Duties, or Offices of Man in general, and of a good Citizen in particular; wherein I first discourse largely enough concerning the Rules of Human Actions, whether they respect GOD, our SELVES, or our NEIGHBOUR, and tho' in these Three all Human Obligations seem to consist, yet have I not thought much to superadd to these some other Laws of Humanity, and Rules of Covenants and Contracts, whereby all Persons, whether they be in a publick or private Station, may be informed what they are bound to do, and which be the Offices and Duties of Human Life.

Altho

The P R E F A C E.

Altho' throughout this whole Philosophical Work I have endeavour'd to observe a due Order, and to deduce subsequent Truths with all possible clearness from those that precede, yet I thought it would not be besides the Matter, if I should subjoyn some Rules for New Beginners in PHILOSOPHY to observe, in order to the Securing them from Error, and for the right conduct and guidance of their Reason.

First RULE, That they lay aside all the Prejudices of their Infancy, and admit nothing for Truth, which they have not first discuss'd and examin'd anew.

Second RULE, That they be not rash in their Judgments, but always abstain from Judging, as long as they have no clear and distinct Perceptions; and that they neither affirm or deny any thing, except it be of Things that are clearly and distinctly known by them.

Third RULE, That they give great heed to the Question propounded, and warily consider, whether what they suppose themselves to have perceived, do necessarily follow from those Truths, which by a new Examination or Scrutiny they have found out.

Fourth RULE, To distribute the Difficulty they undertake to Examine into so many Parts, as is fitting for the more easie and commodious resolving of it.

Fifth RULE, So to dispose the Members of this Division, as to begin with those that are most simple and easie to be known; observing therein the Order of Nature, as far as may be, and so by degrees proceed to the knowledge of such as are more difficult and compound.

Sixth RULE, To examine all the Parts singly by themselves, with so much Attention and Exactness, that they may be assured of having omitted none; and especially minding, whether they do not oppose and contradict those first Truths and primitive Notions they have already discovered, and clearly perceived.

Thus having gone through the Book of the INSTITUTION, next follows the HISTORY OF NATURE. For seeing that the Truth of the Principles of any Science is made manifest by the Evidence of its Deductions, and that their Certainty is look'd upon as Indubitable, if those Things that are Inferred from them, do wholly depend upon the knowledge of them; I was desirous to try, whether the several Appearances of Nature, or all those Things which our Senses perceive to be in Bodies, did comport with the Principles laid in my INSTITUTION OF PHILOSOPHY, and whether there be such a Connection between them, as that tho' the latter may be Apprehended without the former, yet the former can never be Understood without the latter.

For tho' the Principles I make use of in the Explaining of Things Natural seem to be very plain, as being nothing else but the Magnitude, Figure, Motion, Rest, and Position of Bodily Things; nevertheless I dare affirm, that in this NATURAL HISTORY I have had recourse to no other Principles; and that I have not only explain'd all those Effects, which by the Peripateticks are commonly look'd upon as the Miracles of Nature, without the Auxiliaries of Sympathy and Antipathy, or the assistance of occult Qualities; but have also given a true and Natural Reason of them, so as to leave no room for doubting of their Certainty, especially if it be considered, how many Things concerning Bodies, Qualities, Metals, Animals, &c. are unfolded and cleared from so few and such simple Principles, which certainly could never so well cohere together, except they were true, and out of the reach of doubting.

I confess I have chiefly taken upon me to explain the common Phænomena, and such as most frequently occur; yet must it not be thence infer'd, that I can't with the same ease render a Reason of the more extraordinary, which do seldom happen; since the Cause of all Effects is alike, and forasmuch as whatsoever we meet with in the World hath its Use and End from the same Principles. Wherefore I have generally forbore mentioning such as those, lest I should seem to stand in need of strange and uncommon things, to demonstrate the Certainty of my Principles, or to have recourse to Monsters and Prodigies to be my Witnesses of their Evidence.

My Design therefore in this Work was, not to describe the whole HISTORY of NATURE, or to comprehend in One Book all the Phænomena of the Universe, since that would be an infinite Task; but only to make out, that all the Things we see do perfectly well agree with the Principles I have establish'd in my INSTITUTION of PHILOSOPHY; and that nothing is handled by the Philosophers of any Sects whatsoever, which is not accommodately, yea, more distinctly and clearly explained by these Principles.

The First Part therefore I begin with is the Nature of a BODY, and at the very beginning endeavour to prove against EPICURUS and the most Famous GASSENDUS, that there is no empty Space to be found between the Parts of Matter: That the Arguments and Experiments which they alledge for the proving of a Vacuum are to no purpose, and wrongly applied. And in the next place proceed to the Affections of Bodies; where, after I have asserted the indefinite Divisibility of a Body, I lay down several Experiments of Bodies, Thin and Close, Hard and Fluid, Rough and Smooth, Transparent and Dark, Bended and Comprest, assigning the true Reason of their several differences.

And

Of the Means
and Helps
which conduce
to Philosophi-
zing.

First Rule.

Second Rule.

Third Rule.

Fourth Rule.

Fifth Rule.

Sixth Rule.

The Design
of the HISTO-
RY of NA-
TURE.

The First Part
is, Of the Na-
ture of a
BODY.

The P R E F A C E.

The Second
Part is, of *Qualities*.

And forasmuch as Qualities do always accompany Material Substance, and affect and determine the same in whatsoever State the same may be; I was willing to demonstrate the true Nature of them by Experiments, shewing that they consist in Quantity, Motion, Figure, and Position of Parts; which afterwards I make manifest by the Examples of Heat and Cold, Heaviness and Lightness; Taste, Smell, Sound, Colour and other Affections of Bodies which strike our Senses. Which done, I discover those Effects which are commonly attributed to unknown Qualities, which they term Occult, and declare the Causes of them.

The Third
Part is, of the
World and
Heaven.

Afterwards I proceed to the History of the WORLD and HEAVEN, taking my rise from the Beginning of the World, which is followed by the Generation of Things, and the Ordering of the several Parts of the World, with the end that threatens it from the Generation and Corruption of Things: After these come the Phænomena of the HEAVEN, SUN, and FIXT STARS, and the Spots that appear in their Bodies: And next to these the PLANETS and COMETS: And then from various Examples enquire, whether they have any Power upon us, or Inferior Bodies, or Foretel anything with Certainty, and declare what we ought to judge of these kind of Predictions.

The Fourth
Part is, of
the Four
Bodies.

The Fourth Part is taken up by the Four great Bodies: First, The EARTH, which is almost to be look'd upon as nothing, if compared with the Universe: Next, the WATER, with its various Properties: Then the Rivers and Fountains, whose rise is discovered; and after those the Sea, with the Cause of its Ebbing and Flowing: These being the Things that have not only troubled the Heads of the Philosophers of this Age, but also those of the Ancients, and forced them to betake their refuge to occult Qualities. Next to the Water, the Phænomena of the FIRE are discovered, the Effects whereof are very different, as Earthquakes (which don't affect the whole Globe, but only some part of it) Glafs and Coals, which are produced by its Operations; and many other Things are Explained, not only of those which are generated here with us on the Surface, but also in the inward Parts of the Earth. And lastly, the AIR brings up the Rear of the Elements, whose power and efficacy appears as well in Natural as Artificial Things.

The Fifth Part
is, of *Fossils*.

And forasmuch as the Earth doth hide many Things in its Bowels, which deserve our Consideration, I have added something concerning FOSSILS, viz. Things dug out of the Earth in general: And first of Quicksilver, Brimstone, Salt, Gold, Silver, Tin, Lead, Brass, Iron, and other Minerals, whose Generation is no less wonderful than their Operations and Effects. This done, I proceed to the Stones, and having discussed their various generations, I examine their distinction and different Constitution: And lastly, consider the LOAD-STONE, which tho' it be reckon'd amongst common Stones, and hath nothing of lustre, yet has very singular effects, and such as are astonishing to those, who do not own the Striate or Screw-like Matter to be the Cause of them.

The Sixth Part
is, of *Meteors*.

After this, I proceed to the discovering of the Phænomena of METEORS, whose place as it is between the Earth and the Stars, so they seem to participate of both their Natures. First, I open the Nature of Vapours and Exhalations, and what goes to the forming of them: Then speak of the WINDS, which like wandering Travellers never rest. These are followed by Rain, Hail, Snow, Dew and Honey; and then I declare the rise and effects of TEMPESTS and THUNDER; also why LIGHTNING is so fierce, and why it seizeth hard Bodies without touching those that are soft. Amongst Meteors, the RAINBOW challengeth the first place, and other Fires kindled in the Air, which as they do more closely or loosely stick to their Matter, so they vanish sooner or later.

The Seventh
Part is, of
Plants.

After these comes the Seventh Part, concerning PLANTS, whose variety is almost infinite; where first I discourse of their Parts, Virtues and Qualities, whether hid or manifest, that are common to every Plant. Then I explain the Sympathy and Antipathy of some of them, adding something of their rise, nutrition, germination and decay, as much as may seem sufficient not only to understand their Phænomena, but also their whole Nature.

The Eighth
Part is, of *Animals*.

I begin my Treatise of ANIMALS with those that are begot of themselves, or as others will have it, begot of putrefaction, and from them proceed to Animals that are produced from Seed. And having enquired into the Cause of MONSTERS, I speak concerning their different Time in bringing forth; and then passing over to their Affections, I search into the Causes of HUNGER and THIRST, and of the CIRCULATION of the BLOOD; and then consider what it is in them that is the Principle of such various Operations, and make out that they are performed in them Mechanically, without any perception or knowledge; why some of them hate, and others love one another; and lastly, why some sleep more, and others less; and why they are subject to different Diseases.

The Ninth
Part is, of
MAN.

This whole History is concluded with MAN, who in the becoming Form of his Body excels all other Creatures of the World, as well as he exceeds them by his Reason, Understanding, and his Soul or Mind: For tho' he makes use of the same Organs of the Senses, with other Animals; yet he doth not perceive the Objects of them as they do, since Sensation is a kind of Cogitation in him,

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him, which is not compatible to Brutes. And thus having explained some Experiments concerning Feeling, Tasting, Smelling, Hearing and Seeing; I proceed to Imagination and Memory, and lay open the Cause of Sleep and Dreams. And lastly, having described the Causes of Passions that outwardly appear, I Conclude this my Natural History, with the peculiar Natural propensities and averfions of some Persons, the Original whereof tho' of long time hid, is now made plain and perspicuous.

The Third and Last Book, is of the want of SENSE and KNOWLEDGE in BEASTS; where, tho' from the Beginning of the World it hath been the Common received Opinion, that Brute Beasts are endowed with Sense and Knowledge, and consequently that they are but gradually distinguish'd from Men, yet I make no scruple in this Discourse, to deprive them of those Operations, and to render them meer Machins, which by the furniture of Organs they are provided with, exert their several Actions, and perform all those wonderful things which most Men think can't be done without Knowledge. For seeing that Sense and Knowledge do include an immediate Consciousness of Perceptions, which it is Contradictory to suppose in the most subtil or refin'd Body that may be, I think that Beasts ought to be deprived of them both, and that they are neither more nor less than meer Engins or Machins. But what will some say; Have not the Beasts then any Senses or Appetites? Yes, they have; but without understanding or knowing what they do so feel or desire: For this is the peculiar Excellency of MAN, whereby he exceeds Beasts. For in them is nothing to be met with besides several Motions, which may as well be found in an Artificial Machin, as has been seen in the Flight of an Artificial Fly, and in that Iron-Statue, which after many Turnings and Windings presented it self before the Emperour of Morocco, kneeled down, delivered a Petition, and then rising again, returned the same way it came, as Historians assure us. Accordingly it will appear, that all those Motions which we perceive in Beasts, are only determined by the Animal Spirits, with the help of the Nerves and Muscles, and are performed in the same manner, as in us, when we do any thing without minding or knowing what we do: For indeed tho' such Actions be done in us, yet they are not properly done by us; wherefore I allow no Soul in Beasts, besides the Blood, which being a fluid Body, and swiftly moved, its more subtil part, which we call Spirit, and continually is carried by Arteries to the Brain, and from thence into the Nerves and Muscles, moves the whole Body, as I have fully here demonstrated.

The Design of the Discourse, concerning the want of Sense and Knowledge in Beasts.

Here is nothing more to be said, unless it be to acquaint the Reader, That tho' the Three Treatises contain'd in this Volume, have been well received in their former Dresses, both at home and abroad, having been often Printed here in England and in Foreign Countries, the last having been also Translated into French by Monsieur De VILLEMESMES, then Counsellor to the present French King. Yet to make them more useful to all Persons, I have now carefully Reviewed, Altered, and Enlarged them all; so that this whole Work, in all its Parts, is more Compleat and Perfect, than what has hitherto been Published in any Language.

This Work in all its Parts, more Compleat and Perfect than hitherto Publish'd.

Anthony Le Grand.

T H E



T H E
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An Explanation of the Sculptures in this Work.

First in the INSTITUTION of PHILOSOPHY

TH E *Tute*, represented by the Figure of *Fidelity*, sitting on a *Chair* ascended by three *Steps*, which Steps are Emblems of those three Parts of *Philosophy*, over which we must pass, before we can arrive at the perfection of *Truth*; her *Eagle* denotes her quick-sightedness, by which she is able to read the *Book*, held at that distance, *clear & distinct* (plainly and distinctly) as is therein written, whilst the *Sun* that seems to enlighten the *Book*, is an Emblem of that assistance *Heaven* freely affords us in our virtuous pursuit of *Learning* and *Knowledge*: The Figure with its Foot on the first Step of the ascent, as likewise that with the *Globe*, and the other behind are Emblems of some *Proficients* in *Philosophy*, their particular progression in that noble Study being denoted by *precedency* of order.

In the *Preface*, the *Sculpture* represents the several *Pourtraitures* of those *Philosophers*, cited by the *Author* in his *prefatory Discourse*; those standing on the fore-ground, are *Descartes*, *Gassendus*, *Epicurus* and *Zeno*, the fittest to have the first place in this *Sculpture*, since by their *Works* they contributed most to the building this *Body of Philosophy*; which Emblem may likewise teach us not to be forgetful of those from whom we have received Benefits.

LOGICK, Part 1. Chap. 1. fol. 1. Represented by a *Woman* sitting in a *Chair*, holding in her Right Hand a two pointed *Sword*, and in her Left a *Serpent*, who twists about her *Arm*; on her Head, a *Helmet* surmounted by an *Eagle*; beneath her Feet are *Books*, *Swords* and *Garlands*, with *Boys*, having *Keys* and *Locks* in motion; at a distance two *Philosophers* discoursing: Her *Swords* are her most proper Emblems, *Logick* being *pugnatio Verborum* (a Word-fight); her *Snakes* denote her subtilty, her *Helmet* her strength, and her *Eagle* her discerning faculty; the *Locks* and *Keys* denote her power to lay open or conceal; the *Garlands* on the *Pedestals* of the *Pillars*, are the *Trophies* of her *Victories* gained over other parts of *Learning*, which *Victory* is represented by her having *Books*, *Swords* and *Garlands* laid at her Feet; the *Sword* occupying her Right Hand, and the *Snakes* her Left, denotes Powers, being nobler than cunning: The building in prospect, is the *School of Learning* dedicated to the Goddess *Minerva*.

LOGICK with *Truth* and *Falshood*, Part 1 Chap. 2. fol. 3. The Figure which seems just risen from her *Chair* is *Logick*, as appears by her usual Emblems, (treated of before) the Figure whom she seems to court, is *Truth*, represented with a *Glory* round her Head, having a loose *Garment* cast about her; the *Glory* denotes her Excellence, and her regardless *Robe* shews that *Truth* needs no Ornament, nor ought to be covered, tho' with the

most pleasing and becoming pretences: The Figure next her, represents *Falshood*, being a *Siren* with a *Mask* and *Mirror*, the proper Emblems of that Vice, it being reported of that Creature, that she destroys with her Voice all that give ear to her; her *Mirror* denotes the double dealing of *Falseness*, and her *Mask* the disguises she is forced to make use of (for as it is said of *Virtue*, that could Men see her Naked, they would be most passionately enamoured of her,) so on the contrary, could they see *Falsity* undrest of her *Masks* and *Disguises*, they would flee from her, as the ugliest and most dangerous Monster. The Building behind, represents the Palace of *Logick*, being the *School of Learning*.

LOGICK discovering *Falshood*, Part. 1. Chap. 2. Rule 1. fol. 5. The representation of *Logick* as before, viewing intently the *Siren*, who has covered her Face with a *Mask*, under which appearance she endeavours to pass for *Truth*; but her lower parts being her badge of distinction, are uncovered by a little Boy, and so she is detected; which shews that the best mask *Falshood* is discoverable by *Truth* and *Innocence*, tho' in its Childhood.

LOGICK embracing *Truth*, Part 1. Chap. 2. Rule 4. fol. 8. The *Sculpture* represents a *Garden*, in which the Figure of *Logick* appears together with *Truth*, both emblemis'd as before; the seeming Imbraces of *Logick* given to *Truth*, denote the acceptableness of it to *Learning*; they being placed in a *Garden*, is to shew the Pleasures and Sweets that attend them both.

JUDGMENT, Part. 1. Chap. 11. fol. 26. Represented by an elderly *Man* sitting on a *Rainbow* in the *Clouds*, having *Books* and a *Scrole* of *Parchment* under his Left Foot, on his Right Knee a *Book* opened; the Figure standing by *Judgment*, is *Logick*, and points towards the opened *Book*: The Building is the prospect of a *Theatre*, the *Books* and *Serpents* under, are the Emblems of *Learning* and *Wisdom*, the inseparable Companions of *True Judgment*, who is represented elderly, as a Badge of Experience, and placed in the *Clouds* to shew his inspection of all Human Affairs; and the various Colours of the *Rainbow* he sits on, denote the various Methods he makes use of to be informed, and the brightness of its Rays, the clearness of his apprehension, and the seeming information given him by *Logicks*, pointing to the *Book*, shews the necessity of *Learning*, to enable us to make a true Judgment.

REASONING, Part 1. Chap. 15. fol. 33. Represented by an elderly *Woman*, sitting on a *Pedestal*, leaning her Head on her Left Hand, with *Books* under her Left Foot and Elbow, in her Right Hand a *Book* a little opened, her Forefinger therein, and a *Scrowl* hanging from below the *Book*, with this Motto, *in perfecto quiescit*; the Figure stand-

(b)

An Explanation of the Sculptures.

standing in a *Glory*, incircled with *Clouds*; and on which *Reasoning* seems to have her Eye, represents *Truth* holding a *Book* in her Right Hand, and a Branch of *Palm* in her Left, having the *Globe* of the *Earth* under her Foot: On the Fore-ground are *Boys* and *Books*. The Motive for representing *Reasoning* by these *Figures*, are these, 'tis represented by a *Woman*, to denote its productive Faculty, right *Reasoning* being the common *Mother* of every great *Good* and wise *Action*; the *Books* under her Foot, denote some doubts she hath long since overcome; and those under her Elbow, some doubts just removed; her melancholy *Posture* and *Air*, shew the necessity of seriousness in *Reasoning*; the *Book* in her Right Hand, seems to contain (and more especially that part which she engageth with her Forefinger) what is express'd in the *Scrole* that hangs from it, which is, that by the help of *Reasoning* we may bring all our undertaking to that perfection as will afford the means of being at rest: The placing *Truth*, as in the description, is to shew, that *Reasoning* hath always *Truth* in view, that being the End she aimeth at; the *Glory* incircled with *Clouds*, express the inward Beauties of *Truth*, tho' sometime vail'd with *Clouds* of Ignorance; the *Book* and *Palm* which occupy her Hands, are Emblems of those *Goods* she gives her Possessors, Peace and Knowledge; and her Foot being placed upon the *Terrestrial Globe*, denotes her excellence above all earthly things.

CONTEMPLATION Part 2. Introduction, fol. 53. The *Sculpture* represents a *Woman* kneeling at her Devotion, having beneath her the *Globe* of the *Earth*, with Eyes covered, holding a *Scepter* in her Right Hand, and on the same side, the *Sun* in *Glory*; and on her left side the *Moon* and *Stars*, which she seems to inspect with care; above in the *Clouds*, the *Glory* of the Supreme *Deity*, with the word *Jehovah*, environ'd with Blessed *Spirits* in postures of Adoration: She is placed above the *World*, to shew that those who seriously contemplate the *Glory* of *GOD*, must be contempters of the *World*, and have their Eyes, like hers, vail'd to all its Inducements, flattering Joys and Temptations; her *Scepter* denotes the power of heavenly Contemplation, we being thereby made more than *Kings* and *Conquerors* (according to the Scriptures;) her contemplating the *Sun*, *Moon* and *Stars*, shews that whosoever soberly considers the wonderful Creation of those *Glorious Bodies*, will think their time best employ'd in contemplating with Gratitude and Wonder the Excellence and Power of that *GOD* who made them.

FATE and WILL Part 2. Chap. 5. fol. 62. The *Figure* on the Right Side with folded Hands, and clad in a full Garment, is *Fate*; his folded Hands are Emblems of Unchangableness, and his full Garment resembles his Amplitude; the Golden Chain which seems to fall from the *Star* in *Glory*, on which *Fate* looks, and with which both he and the other *Figure* who represents *Will*, are incircled, shews the necessity of the *Wills* complying with *Fate*, being bound thereto with a Chain of Coelestial Causes; the Wings of *Will* are Emblems of her swiftness; and her extended and erected Hands and Head towards Heaven, shews we will every thing under the appearance of *Good*.

PROVIDENCE, Part 2. Chap. 16. fol. 74.

Represented by a *Woman* sitting on a *Pedestal*, her Right Arm leaning on a *Wheat-sheaf*, and on her Left a *Boy* winged, bringing her a *Cornucopia* of Fruits and Flowers, as shewing the great goodness of *Providence*, who gives not only on the Right, Corn to support the necessity of Nature, but also on the Left, Fruits and Flowers to recreate and cherish it: At a distance in prospect is a *Corn-field*, in reaping time, brought to its maturity by that *Eye* of *Providence*, which from out of a *Glory* inspects it, and thereby demonstrates that *GOD* in his *Providence* vouchsafes to look down from his all *Glorious Throne* of Heaven to bless the *Goods* of the *Earth* to Mans use, which ought to draw from us returns of Praise and Thanksgiving.

SPIRITS, Part 3. Introduction, fol. 76. In the *Clouds* are represented *Choirs* of blessed *Angels* playing on *Musical Instruments*, and singing and praising *GOD*. In a *Cavern* below, are represented the *Infernal Spirits*, seeming to utter hideous Cries and Groans, the effects of the anguish they suffer in themselves, and that raised in them by their enviously beholding the happiness of the Blessed above; for true Happiness is by nothing so much express'd as by praising *GOD*.

NATURE of ANGELS, Part 3. Chap. 1. fol. 77. In the *Clouds* appears a *glory* of *Angels* and *Cherubims* contemplating with desire and joy, the *Glory* of *GOD* which appears above, half veild by a dark *Cloud*; it being the Nature not only of *Angels*, but of all good Men to behold with Praises and Adoration that *GOD* who made them for that end.

MOTION of ANGELS Part 3. Chap. 5. fol. 82. Represented by several *Angels*, occupying themselves in doing the service acceptable to their Creator, as bringing Peace and Reward to the Good on *Earth*, which is shewn by those two, who bear a *Coronet* and *Branch* of *Palm* downwards, as likewise in carrying the *Actions* and *Prayers* of the *Just* to Heaven, shewn by that *Angel* who bears the *Pot* of *Incense* towards the *Sky*; and by the other who is uncovering the Monument of *King Charles* the Second, to lay, as it were, open the good *Actions* of that best of *Princes*, to that *GOD* who will reward them.

ORDER NUMBER and DISTINCTION of ANGELS, Part 3. Chap. 6. fol. 83. The *Sculpture* represents the three *Hierarchy* of *Angels*, and in each *Hierarchy* the three *Orders*; the 1st. containing *Seraphims*, *Cherubims* and *Thrones*, the 2^d. *Dominions*, *Virtues* and *Powers*; the 3^d. *Principalities*, *Arch-Angels*, and *Angels* with *Palms*, *Swords* and *Crowns*, denoting their *Offices* of Peace, Power and *Glory*, given them by that *GOD*, who is represented above them, and who made, ordered, numbred and distinguished them for his Service and *Glory*.

DEMONS, Part 3. Chap. 10. fol. 88. In a gloomy *Cavern* are represented the nine degrees of *Demons*, or *Infernal Spirits*, distinguished by their monstrous and ugly variety, and which (according to the Discourse) they are known by: The first termed *Belzebub*, generally allowed Sovereign *Emperor* over all the rest, tho' his Name signifies no more than *King of Flies*; the 2^d. *Python*, 3^d. *Be-lial*, 4th. *Asmodeus*, 5th. *Satan*, 6th. *Merim*, 7th. *Apolyon*, 8th. *Asthorath*, and 9th. *Mammon*: The *Figures* in the *Air* are *Angels*, bearing up a *Child*

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Child, whom they had rescued from the *Devils*: The reason for the precedency of these *Devils* to one, the other ariseth from their greater or lesser power in doing hurt, and therefore some people may wonder why *Mammon*, who is taken for the *Devil of Riches*, should be placed last, the power of *Gold* in doing ill being the greatest.

CARE of ANGELS, Part 3. Chap. 1. fol. 89. Represented by an *Angel*, rescuing and protecting a young *Man* from the fury of the *Devil*, and by two *Angels* driving a *Demon* before them, the defending us from the assaults and snares of the *Devil*, and driving him from us, being their constant employment and care.

PHISICKS, Part 4. Chap. 1. fol. 91. Represented by a *Woman* with a *Sphere* and *Books*; on her Right Side an *Eagle*, and on her Left two *Boys*, having a pair of *Compasses* and a *Square*; the three *Figures* in prospect are three *Philosophers* in consultation concerning the *Planets* and *Stars*, the *Books*, *Mathematical Instruments*, and *Eagle* are Emblems of the quicksightedness, Learning and Practice requisite to the true understanding of *Phisicks*.

DURATION and TIME, Part 4. Chap. 24. fol. 131. *Time* is represented by *Saturn*, being an Old *Man* bald Headed except one *Lock*, and standing on Tiptoe with one Foot on a *Rock*, having a *Sybh* and *Hourglass*: *Saturn* is feigned by the *Poets* to be the Father of the *Gods*, the first beginner of *Time*, his *Age* and *Bald-pate* denote his antiquity and duration, and his one *Lock*, the one punctum of *Time* present, by which we ought to hold; he stands on Tiptoe to shew he hastens to be gone; his *Hourglass* and *Wings* are Emblems of his never resting and swiftness, and the *Sybh* the destruction and consumption he makes of all things. The four *Figures* below him, represent the four *Seasons* of the *Year* and parts of *Mans* Life, following one another towards the *Temple of Eternity*; our *Childhood* brings *Youth*, *Youth* brings *Manhood*, *Manhood* Old *Age*, and Old *Age* to that *Eternity* properly described by the *Circle* over the *Temple*, and the *Hoop* in the *Boys* Hand, being what are in appearance without end.

The Motion of the PLANETS, Part 5. Chap. 1. fol. 134. Represented by *Sybell*, having a *Castle* on her Head, and sitting on *Lions*, placed on the *Globe* of the *Earth*; the *Castle* and *Lions* denote the strength of the *Earth*, both in respect to its *Creatures* and *improvements*, the *Lion* being the strongest *Animal* made by *Nature*, and a *Castle* the strongest thing made by *Art*; her having the *Castle* on her Head, and the *Lions* below her, shew the strength of *Human Art* is greater than the strength of *Beasts*; the seven other small *Figures* are bodily representations of those *Poetical Heathen Gods*, whose Names are made use of to distinguish the *Planets* by; that in the midst and over the *Earth*, is *Apollo*, encircled with *Light*, as *God of the Sun*; his *Bow* and *Arrow* denote the piercing power of his *Rays* and *Sun-beams*: That standing on a *Cloud*, and under the *Earth*, is *Luna*; the *Bow* in her Hand, and *Crescent* on her Head, are Badges of her two-fold *Divinity*; the first as she is Goddess of *Hunters*, by the Name of *Diana*; the last as Goddess of the *Moon*, by the Name of *Luna*, as above: The *Figure* over *Apollo*, is *Mercury*, the *Wings* of his Feet denote his swiftness in running, as his Staff twisted with *Snakes* doth his Cunning;

those being the peculiar Excellencies given him by the *Poets*, and the *Qualifications* that rendered him capable of the great Employments he possesseth, of being *Envoy* and *Currier* in Ordinary to the *Gods*: The *Figure* on the Right Side of *Apollo*, is *Venus*, the *Star* on her Forehead denotes her *Divinity*; her *Doves* are Emblems of *Love*, and properly joined to her who is the Goddess of *Love*. Over *Mercury* stands *Mars*, who bears a *Sword* and *Buckler*, being accounted the *God of War*; that on the Left Hand is *Jupiter*, the *Thunderbolts* in his Hand, and the *Eagle* under him are the *Coat Armour* of *Heaven*, of which by the same Authority, he is accounted *God*: That on the Right Side is *Saturn*, his *Wings* denote the fleeting of *Time*, of which he is reported *God*, and the *Sybh* in his Hand, shews the destruction made of all things by this *Divinity Time*.

The SUN in GLORY, Part 5. Chap. 14. fol. 157. Within a *Glory* is represented, *Phæbus* in his *Chariot* drawn by white *Horses*, they being the *Creatures* he is said to have ordered to be offered up to him in *Sacrifice*; beneath lies a *Shepherd* and his *Dog* a sleeping, who are recovered from their drowsiness by the brightness of his *Rays*, and the warmth of his *Beams*, which cherish and enliven all *Human Creatures*.

The MOON, COMETS, &c. Part 5. Chap. 17. fol. 162. The *Figure* covering his Eye with his Finger, is *Archimedes* a viewing the *Moon*, *Stars*, and other *Planets*, through a *Telescope*; and that *Figure* next him is a *Philosopher* discoursing him about some *Planetary Observations*; upon and below the *Table* are several *Mathematical Instruments*, as *Squares*, *Globes*, &c.

The EARTH, Part 6. Chap. 1. fol. 179. Represented by *Sybell*, drawn by *Lions* in her *Chariot*, having a *Castle* on her Head, and the *Globe* of the *Earth* beneath her: The reason for representing the *Earth* by this *Figure*, is given before in the *Treatise of the Motion of the Planets*: The *Angel* bearing *Fruits* and *Flowers*, as it were from *Earth* to *Heaven*, denotes that the sweetest things of the *Earth* ought to be offered up to the *GOD of Heaven*, who made and preserves the *Earth*.

DAY and NIGHT, Part 6. Chap. 5. fol. 187. The *Figure* of the *Young Man* with *Wings* holding a lighted *Torch* in his Right Hand, and a *Serpent* in a circular form in his Left, having one Foot on a *Cloud*, and the other on the light part of the *Globe*, represents *Day*; his *Youth* is the *Morning*, and his lighted *Torch* the *Noon*; his circular *Serpent* shews the motion of *Time*, and his treading on a *Cloud*, that he puts *Darkness* under his Feet; behind the *Globe* on the backside, slipping away as it were, stands a *Woman* Winged and Cloathed in a *Sables Garment*, embroidered with *Stars*, having on her Head a *Crown* of *Poppeys*, representing *Night*; her Posture shews her not to be able to stay in presence of *Light*; her Garment is her proper Emblems, and her *Poppeys* are promoters of *Sleep*, the true business of the *Night*: The *Element* below her spangled with *Stars*, shews the descending of *Night* at the ascending of *Day*.

The WATER, Part 6. Chap. 11. fol. 202. Represented by *Tethis*, whom the *Poets* have said to be Goddess of the *Sea*; her *Chariot* is drawn by *Dolphins*, accounted the best natured and most compassionate *Fish*; and for that reason preferred to the

horror

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honour of drawing their *Queen*: Over her is the *Figure* of a *Boy*, who pours *Water* out of a *Watering pot*, as intimating that we have *Water* from above in *Rain*, as well as below in *Rivers*.

The AIR, Part 6. Chap. 13. fol. 207. Represented by the Goddess *Juno*, Wife of *Jupiter*, sitting in a *Charriot* drawn by *Peacocks*; she is accounted by the *Poets* as Goddess of the *Air*, and is drawn by these *Birds* as the most beautiful *Creatures*, to compleat whose beauty, she hath adorned their *Tails* with a hundred refulgent *Eyes*, taken from *Argus*, to whom she had given them, the better to see into the Amorous Intreagues of her Husband *Jupiter*, of whom she was Jealous, but *Argus* being kill'd by *Jupiter*, she reassumed her Gift and disposed of them as above.

The WIND, Part 6. Chap. 16. fol. 211. Represented by a *Figure* Crown'd and Sceptr'd, being *Aeolus*, the *Poetical God*, and *King of the Winds*; on each side of him are two *Figures*, representing the four *Winds*; the lowest on the Right Hand is *Boreas*, the *North wind*, depicted like an *Old Man*, with *Bats Wings* and a *Serpents Tail*; his *Bats Wings* denote his blowing most in *Evenings* and *Nights*, and the *Serpents Tail* his stinging *Colds* and *Blasts*; above is *Eurus* the *East-wind*, represented also by a *Man* with *Wings*, to shew the swiftness of his motion: The uppermost on the Left Hand is *Auster*, the *South-wind*, represented by a *Young Man*, and below him *Zephyr*, the *West-wind*, represented by a *Man* pouring out *Water*, as generally bringing *Rain* along with him; they are all blowing out *Winds*, which occasions a *Tempest*, as appears by the foaming and raging *Billows* of the *Sea*, that seem to overwhelm the *Ships* therein.

THUNDER, Part 6. Chap. 19. fol. 217. Represented by *Jupiter*, who, as before is said, is accounted the chief *God of Heaven*, and the *Inventer* and *User of Thunderbolts*, having as 'tis storied, been forc'd to contrive this *Weapon* to defend his *Celestial Kingdom* against the assaults of the *Giants*, who dared to attempt the *Invasion* of it; they are made by *Vulcan*, the *Black-Smith in Ordinary* to the *Gods*, and accounted as such himself, and are of that subtle contrivance, that they at once *kill*, *burn* and *astonish* without being seen; for which reason there is no *Guard* to be made against them; he is set upon an *Eagle*, the *Emblem of Quickflight* and *Power*; for as that *Bird* only can gaze on the *Sun* with unmoved *Eyes*, and destroy with her *strength* whom the *pleases of the Birds*, so *Heaven* only has power to discern our *Actions*, and to punish where it thinks fit: The *Figures* below represent two *Men*, covering their *Heads* for fear of the *Thunder*, and affrighted at its noise; the *Houses on Fire*, the *Trees Blasted* and beaten down are the visible effects of *Thunder*, and may admonish us to beware of offending *Heaven*, who can destroy with its *Breath*.

The FIRE, Part 6. Chap. 21. fol. 221. Represented by *Vulcan* standing in his *Charriot*, which is drawn by *Sea-dogs*, at work at an *Anvil*, being furnished with *Fire* from *Mount Aetna*. *Vulcan* is the fam'd *Blacksmith* to the *Gods*, as is before said, and consequently a great *Dealer in Fire*; the two *Sea-Dogs* chained to, and drawing his *Charriot*, are *Emblems* of the predominancy that *Fire* hath over its contrary *Element the Water*; and by *Mount Aetna* is shewn the power of this hot *Element* even in the *Earth*.

ANIMALS in general, Part 7. *Introduction*, fol. 229. In the midst a *Man* contemplating with admiration the variety of *Beasts* and *Fowls* about him.

GARDNING, Part 7. Chap. 12. fol. 245. The representation of a *Garden*, in which the four *Figures* are *Gardners*, employed in so many several *Actions* belonging to that Ingenious Art, as *Digging*, *Grafting*, *Inoculating* and *Screening of Earth*; in prospect a *Fine House*.

ANIMALS, Part 7. Chap. 17. fol. 252. The representation of several *Animals*, and more particularly those extraordinary in their kind, as the *Horse*, *Elephant*, *Lion*, *Camel*, *Deer*, *Bear*, *Swine*, *Sheep*, *Dog*, &c.

CREEPING THINGS, Part 7. Chap. 19. fol. 256. Represented by a *Tortoise*, *Crocodile*, *Lizard*, *Serpent*, *Mole*, &c.

FOWL or FLYING ANIMALS, Part 7. Chap. 20. fol. 257. Represented by the *Ostridge*, *Eagle*, *Peacock*, *Swan*, *Turkey*, *Cock* and other *Birds*.

FISH or SWIMMING ANIMALS, Part 7. Chap. 21. fol. 259. Represented by the *Salmon*, *Pike*, *Lobster*, and other *Fish*; in prospect some *Men* in *Fishing Boats*, and *Nets* a catching *Fish*.

INSECTS, Part 7. Chap. 22. fol. 261. Represented by several sorts of *Butterflies*, small and great *Flies*, *Grashoppers*, &c.

MAN as to his BODY, Part 8. Chap. 1. fol. 264. The *Figures* represent *Man* in his compleat *Body*, composed by *Bones*, *Flesh* and *Skin*: That on a *Pedestal* on the Left, is perfect, the next is the *Muscular*, having his *Skin* off, and the next an *Anatomy of Human Body*; the *Figures* seeming to inspect them, represent *Physicians* as consulting.

The five *SENSES in general*, Part 8. Chap. 10. fol. 283. 1st. *Smelling*, represented by the *Figure* holding a *Flower* to her *Nose*. 2^d. *Hearing*, represented by a *Young Woman* playing on an *Instrument of Musick*. 3^d. *Tasting*, represented by a *Young Woman* filling a *Glass* of *Wine*, and by her side a *Munkey* eating an *Apple*. 4th. *Feeling*, represented by a *Woman* pulling a *Snake* from her *Hand*, and by two *Cocks* fighting. 5th. *Seeing*, represented by a *Woman* in a *Habit of a Falconer*, having a *Hawk* on her *Fist*, ready to be cast off at that *Bird* in the *Air* which the seems to view.

FEELING, Part 8. Chap. 12. fol. 286. Represented by a *Woman* seeming to snatch her *Hand* from a *Parrot*, who seemsto bite it; at the same time a *Dog* is pulling her by the *Coat*; as also by that feeling story of the *Monkey* making use of the *Cats Paw* to pull the *Chestnut* out of the *Fire*; and by a *Mans* beating a *Dog*, and by the fighting of two *Birds*, all true *Emblems* of this noble *Sense*.

TASTING, Part 8. Chap. 13. fol. 288. Represented by two *Women* in a *Garden*, the one seated and eating an *Orange*, expressing by her gay *Air* the pleasure afforded her by that noble *Sense*; the other is the *Figure* of a *Woman* pulling some *Fruit* in order to eat it; there are also *Cupids* eating *Oranges*, to shew the pleasures of *Love* consist chiefly in *Tasting*.

SMELLING, Part 8. Chap. 14. fol. 290. Represented by two *Women* in a *Flower Garden*, and smelling the *Flowers*: By a *Blood-bound* in *Scent* after his *Game*; as likewise by an *Incense Pot* smocking with *Perfumes*, being the most pregnant *Emblems* of that *Sense*.

HEARING, Part 8. Chap. 15. fol. 292. Re-

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Represented by a *Woman* playing on an *Organ*, having two *Women* standing behind her, with *Musick-Books* in their Hands, and seeming to sing in consort; and by a *Cock* pearching on a *Pedestal*, being the Creature who hears at a greater distance than any other.

SEEING, Part 8. Chap. 18. fol. 297. Represented by a *Man* with a *Prospective* in his Hand, standing on a *Hill* viewing an *Ingagement* of *Ships* at some distance, and by a *Figure* lying on the fore-ground, having his *Eyes* fixt on the *Sea*, which seems at a distance.

MEDICIN, Part 8. Chap. 24. fol. 315. Represented by the *Serpent Python*, surmounted by *Apollo*, the God of the *Sun*. This *Serpent* is said to *Poison* all the *Herbs* and *Grass* he comes near, and for that reason was destroyed by *Apollo*, who also is the God of *Wisdom*, and properly Emblemiseth *Medicin*, there being, in wisely prepared *Medicins*, a remedy to destroy all poisonous *Diseases*.

MAN as to his MIND, Part 9. Chap. 1. fol. 320. The *Womanish Figure* holding a *Sphere* in her Right Hand, and a *Glory* descending from *Heaven* upon her Head, represents a *Human Soul*; the *Sphere* is the Emblem of its *knowledge*, as to *Human Affairs*, the descending *Glory*, its *Immortality*; on her Right Hand stands *Knowledge*, represented by a *Woman*, who holds a *Torch* lighted in her Right Hand, an open *Book* on her *Lap*; and on the Left Hand is the *Figure* of a *Man*, sitting in a musing posture, having *Wings* on his Back, and represents *Thought*; she is thus attended to shew that the two noblest *Faculties* of the *Soul* are *Knowledge* and *Thinking*.

The **FACULTIES** of the **MIND**, Part 9. Chap. 5. fol. 328. The four *Figures* represent the four *Faculties*. 1st. *Understanding*, represented by a *Young Man*, to denote the Beauty of it, Robed and Crown'd to shew that *Honour* and *Power* attend it; and the *Flame* encircling the Head, is an Emblem of its alliance to *Heaven*, and the *Eagle* is an Emblem of its quickness in perceiving. 2^d. On the Right Hand of *Understanding* stands *Imagination* represented by a *Woman*, to shew its productive Power, which is also shewn by the *Coronet* of small *Figures* she bears on her Head; *Imagination* producing more various forms and beings than *Dame Nature* can boast of; the *Wings* on her Head denote the swiftness of that Faculty. The 3^d. is *Memory*, represented by a *Woman* with a *Helmet* on her Head, to shew the strength of that Faculty; and by her a *Dog* in a *Slip*; a *Dog* is a proper Emblem of *Memory*, enjoying, as by Experience is found, more than any other Creature, of that noble Faculty. The 4th. is *Will*, represented by a *Young Man* Wing'd and Blindfolded with extended *Arms*, and erected Head; the reason for representing that Faculty is given before.

ADMIRATION, Part 9. Chap. 9. fol. 335. Represented by a *Woman*, seeming to have all her *Faculties* at work, by viewing that admirable Object that lies before her; being a *Lion* and a *Lamb* lovingly enfolded, and by other *Figures*, whose Looks spake this Passion; in prospect, a *Building*.

LOVE and Hatred, Part 9. Chap. 10. fol. 337. Represented by *Venus* the Goddess of *Love*, sitting in the *Clouds*, and over her *Cupid* her Son and *Messenger*; the *Arrow* he holds in his Hand, is the *Weapon* that opened the way for the love of the Man below, to the *Heart* of that *Lady*, who seems to embrace him: The *Figure*, as it were stabbing the other with a *Dagger*, represents *Hatred*, and the *Devil* behind him shews the ugly and damnable qualities of that Vice.

AFFECTIONS or DESIRE, Part 9. Chap. 11. fol. 338. Represented by a *Young Woman*, who in the per-

suit of *Honour* and *Riches*, which seem to appear to her at a distance, is thrown down by the *Figure* of *Will*, (represented as usually) and at the same time a *Serpent* bites her by the *Heel*, shewing the misery and pain which attend the desiring or affecting too much above what we want, to sustain Nature, and the Precipice we are hurl'd from by our *Will*, in placing our *Affections* on those *Goods* of *Fortune* which are not in our reach.

JOY, Part 9. Chap. 12. fol. 339. Represented by a *Young Woman*, in a loose Garment, having a *Bottle* of *Wine* in one Hand, and a *Glass* in the other; by her another *Figure* with a *Bottle*, and on the fore-ground *Boys* playing on *Flutes*: This Passion is most properly thus emblemised, *Women*, *Wine*, and *Musick* being the Joy *Heaven* gave us to guild this otherwise bitter Pill of Life.

SADNESS, Part 9. Chap. 13. fol. 340. Represented by a *Woman* in a *Widows* habit, sitting on the ground in a melancholy posture, leaning her Head on her Hand; by her a *Boy* a weeping, and below her a *Boy* with an extinguished *Torch*; above, and at some distance from her, stands an *Urn* impaled with *Cypress Trees*; upon the *Rails* which encompass the *Pedestal* of the *Urn*, stand *Pots* of *Fire* flaming, to the memory of him whose ashes are contained therein: These *Figures* are the properest Emblems of this Passion of *Sorrow*, no state being so void of *Joy* as hers, who being a fond and virtuous *Wife*, is by death robbed of a deserving tender *Husband*; the darkn'd *Torch* held near her, shews she has no flame, but that which burns to the *Manes* of her departed *Lord*.

ETHICKS, to front Part 10. fol. 346. Represented by a *Woman*, seated in a graceful Posture on an ascent, holding a *Lion* bridled in her Left Hand, and in her Right a *Level*; her ascent and graceful Posture, shew the Majesty of this Noble part of *Philosophy*; her bridled *Lion* denote its Power; the force of her Arguments in evincing and clearing, are shewn by her *Level*: On her Right Side are the three Cardinal Virtues, *Truth*, *Justice* and *Charity*; the first represented by a naked *Figure*, holding a *Book* and *Palm Branch* in one Hand, and the *Sun* in the other: 'Tis naked, to shew *Truth* ought not to be covered; her *Book* and *Palm* are the rewards she gives, which are *Peace* and *Knowledge*; and the *Sun* is an Emblem of her Brightness, *Truth* being as clear as the Noon Day: The 2^d. is represented by the *Figure* of a *Woman* veiled, holding a *Scepter*, with an *Eye* upon the top, in her Hand; she is veiled, to shew she looketh not on, nor regardeth the Person of any, but administers *Justice* impartially; her *Scepter* and *Eye* denote her Power and Knowledge: The next is *Charity*, represented by a *Woman* comforting *Children*; on the Left Side of *Ethicks* stand the four Vices, *Envy*, *Drunkennes*, *Lasciviousness* and *Deceit*. The 1st. *Envy*, is represented by an *Old Woman* half naked, having *Snakes* about her Body and Hair; *Age* and *Snakes* are the proper Emblems of this Vice, it being as old as the *Devil*, and poisoning the *Minds* of all that entertain it, as *Snakes* do the Bodies of all that touch 'em. The 2^d. *Drunkennes* is represented by a *Man* a *spewing*, the true loathsome Emblem of that *Gluttonous Vice*. 3^d. *Lasciviousness* represented by a *Woman* in an immodest posture, that being *Lasciviousness*. 4th. *Deceit*, represented by a *Woman* holding a *Mask*, shewing the necessity that Vice hath of being disguised, and of its often appearing under borrowed forms: *Ethicks* is thus attended to shew the *Virtues* she possesseth, and the *Vices* she hath overcome.

The **HIGHEST GOOD**, Part 10. Chap. 3. fol. 350. Represented by a *Young Man*, clothed in a short Garment, with his *Eyes* lift up towards *Heaven*, holding in one Hand an *Olive Branch*, and in the other a burning *Heart*, into which his *Tears* seem to fall, and on his

(c)

Head

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Head the *Glory* of *Heaven* descending, as through a *Cloud*: The highest *Good* consists in these three things, peace of *Mind*, the favour of *God*, and a Heart flaming with desire of *Heavenly things*; and therefore 'tis properly represented by this *Figure*.

THE LAW of NATURE, Part 10. Chap. 8. fol. 356. Represented by a *Young Woman* half naked, having her lower parts covered with a *Lamb-skin*, Emblems of that innocence and modesty prescribed by *Natures Law*; she is placed in a pleasant *Garden*, holding a *Table* on her *Knee*, and a pair of *Compasses* in her *Hand*, measuring two *parallels*, with this Motto *Eque lance*; behind her a *Woman* holding *Books*, and having other *Books* under her *Feet*; all which denote how even just and pleasant the *Laws of Nature* are: On her *Right Side* are the three *Virtues*, *Truth*, *Justice* and *Charity*; and on her *Left Side*, *Envy*, *Drunkenness*, *Malice* and *Pride*, all properly Emblematis'd as before; by the *Virtues* being on the *Right of Nature*, and the *Vices* on the *Left*, we are taught that *Virtue* is more acceptable than *Vice* to *Nature* in her first *Principles*, till she is dabaucht by *Custom* or *Practise*.

PRUDENCE, Part 10. Chap. 9. fol. 359. Represented by a *Woman*, standing in a graceful posture, holding in her *Right Hand* a *Looking-glass*, and in her *Left* a *Serpent*; and over her an *Angel* putting an *Helmet* on her *Head*; on her *Right Hand* a *Cupid*, holding an *Olive Branch* in one *Hand*, and a *Palm* in the other; and on her *Left Side* a *Young Man* with a *Sword* and *Buckler*: The *Looking-glass* in her *Right*, denotes that every prudent *Person* ought to look into, and know themselves; the *Serpent* is an Emblem of *Cunning*, and the *Angel* putting the *Helmet* on her *Head*, expresseth *Heavens* aiding us in all our prudent undertaking: The *Cupid* with *Branches*, and the *Young Man* Armed, denote that *Prudence* brings success in *Love*, and *Victory* in *War*.

TEMPERANCE, Part 10. Chap. 10. fol. 361. Represented by a *Woman*, holding in her *Right hand* a *Bridle* to curb the exorbitant desires of the *Flesh*, and over her *Head* an *Angel*, crowning her with *Lawrels*, having a *Palm* in his *Hand*, thereby shewing that *Heaven* will reward this *Virtue* with *Peace* and *Glory*; on her *Right* a *Cupid*, pouring out *liquor* in a *Vessel*, and on her *Left* an *Elephant*, dividing his proportion of *Corn*, denoting thereby that we must use *Temperance* even in *Love*, and that *Beasts* share in that *Virtue* which men must blush to want.

FORTITUDE, Part 10. Chap. 11. fol. 363. Represented by a *Woman*, holding a *Pillar*, and curbing with a *Bridle* a *Lion*, who seems enraged: In the *Air* is represented *Hercules* with his *Club* and *Lions Skin*; the story of *Hercules*, and the reason for his being so adorn'd is so little estranged, that it needs not be here repeated, therefore I shall only add, that the Emblems of *Corporal Fortitude*, as here described, serve only to enable us to judge of the greater fortitudes of the *Mind* discours'd of in the *Book*.

JUSTICE, Part 10. Chap. 12. fol. 365. Represented by a *Woman*, holding in her *Right Hand* a *Sword*, and in her *Left* a pair of *Scales*; next her a *Boy* bearing the *Fasces* and *Axes* carrying before the *Roman* *Victors*: The *Figures* of the *Men* represent *Philosophers* contemplating *Justice*, that being the work of every wise *Man*; the *Fasces* were *Rods*, with which they used to chastise *Malefactors* for small faults.

MANS DUTY to GOD, Part 10. Chap. 23. fol. 382. Represented by a *Man*, *Woman* and *Boy*, addressing themselves to *Heaven*, in a becoming posture, and in the *Clouds* two *Angels* with *Trumpets*; 'tis represented by these three, to shew that *Men*, *Women* and *Children* are obliged to this *Duty*; the *Angels* with *Trumpets*, de-

note the joy the Blessed have in beholding the *Righteous* *Actions* of *Men*; the *Angel* below pointing to the *Coronet* and *Cornucopia*, is an Emblem of that *Honour* promised to the *Righteous*; the *Flame* three-fold, flaming on the *Womans* *Head*, denotes by its number the *Trinity*, by its heat, the warmth of her *Zeal*, and by its light, the brightness of her *Faith*.

MANS DUTY to HIMSELF, Part 10. Chap. 24. fol. 384. Represented by an *Old Man*, in a becoming posture, holding in his *Right Hand* a *Staff*, having a *Serpent* twisted about it, his *Head* Crowned with *Lawrel*; on his *Right Side* a *Young Man* armed, having on his *Head* a *Helmet*, in his *Right Hand* a *Sword*, and in his *Left* a *Target*; self-preservation is every *Mans* duty to himself, and therefore provident *Nature* hath furnish'd the means; to the *Old* she hath given *Cunning* to save themselves, emblematis'd by the *Old Mans* *Staff*, encircled with *Serpents*, the cunningest and most subtle of *Creatures*; to the *Young*, strength and valour, represented by the *Sword* and *Target*, held in the *Young Mans* *Hand*, whilst the *Figure* of *Justice*, who stands before them both, informs us that both *Old* and *Young* are obliged to be just, not only to others, but to themselves.

MANS DUTY to his NEIGHBOUR, Part 10. Chap. 25. fol. 385. Represented by two *Men* kindly embracing each other; on their *Right Side* are *Justice*, *Love* and *Charity*, with their proper Emblems as before described; and on their *Left*, a *Woman* with a *Cornucopia* of *Fruits* and *Flowers*, the Emblem of *Plenty*; all which denote, that we ought to be friendly in our carriage, just in our dealings, and charitable (according to our ability, to all that want) and that those who do so, shall have plenty of all the *Fruits* of the *Earth*.

CONTRACTS, Part 10. Chap. 27. fol. 387. Represented by the *Platform* of a *Custom-house* *Key*, with *Figures* of several *Men*, denoting a *Merchant*, a *Chapman* and *Porter*; in a *Barge* a *Man* stowing some goods, which they seem to have contracted for.

MUTUAL FAITH or MARRIAGE, Part 10. Chap. 32. fol. 395. Represented by the *Figure* of *Faith*, being a *Woman* almost naked, having a *Glory* about her *Head*; her nakedness denotes her *innocence*, and the *Glory* is the Emblem of that *Heaven* from whence she sprung; she is placed between a *Man* and *Woman*, joining *Hands* as in *Marriage*, to shew that she only can truly perform that *Office*: On the *Mans* side is the *Figure* of *Justice*, an emblem of what he owes to his *Wife*; and on the *Womans*, that of *Constancy*, and a *Cupid* with a lighted *Torch*, denoting that the Duties of a *Wife* to her *Husband* are constant *Love* and *Desire* towards him; the *Torch* is a Badge of the ancient way of performing that Ceremony of *Marriage*, for on the *Wedding-day* they used to light up a considerable number of them, in honour to *Hymen* the *God* of *Marriage*; the billing *Turtles* are emblems of that *Love* and *Harmony* which ought to be between *Man* and *Woman*.

DUTY of PARENTS and CHILDREN, Part 10. Chap. 33. fol. 396. Represented by a *Man* and *Woman*, sitting in a grave and loving posture, having *Children* about them; by their side is the *Figure* of *Justice*, having her *Head* covered with a *Helmet*, and a *Mound* under her *Foot*, to denote that the *Duty* of *Parents* is giving good example to their *Children*, and that their *Justice* ought to take place and surmount all paternal fondness; on the *Right Side* is the *Figure* of a *Woman* veil'd, representing the modesty *Children* must observe in the presence of their *Parents*; the *Stork* by her Side is the emblem of ill *Parents*, it being reported of that *Bird*, that she eats her *Young* Ones.

DUTY of MASTERS and SERVANTS, Part 10. Chap.

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Chap. 34. fol. 397. Represented by a *Woman*, sitting in a graceful posture in a *Chair*, attended on the Right Hand by a *Woman* holding a *Garland* and *Cornucopia*, representing *Plenty*; and on the Left by a *Woman*, bearing a *Sword* and *Balance*, the emblem of *Justice*; before the *Chair* stands a *Blackamoor* Lackney, seeming to receive some *Errand* to go on; beneath the *Figure* of *Plenty* stands a *Maid-servant* attending her *Ladies* Commands, all which properly describe that *Masters* and *Mistresses* are bound in duty to do *Justice* to, and provide for their *Servants* plenty, and that the duty of *Servants* is the careful, honest and respectful performance of all their *Masters* or *Mistresses* lawful Commands.

REGAL POWER, Part 10. Chap. 35. fol. 398. Represented by a *Man*, seated on a *Throne*, *Crown'd*, *Rob'd*, *Scepter'd*, with a *Mound* in his Left Hand, attended on by his *Courriers*, as also by the representations of *Justice*, *Prudence*, *Clemency*, *Fortitude* and *Truth*, as the eternal *Companions* of true *Regal Power*; he being no more properly a *King*, who wants these *Virtues*, than an illiterate *Man* can be a *Judge* of *Learning*.

The Explanation of the Sculptures in the HISTORY of NATURE, Book II.

THE FRONTICEPIECE, represented by a *Woman* looking behind her, and *writing* in a *Book*, which lies on the Back of *Time*, emblematis'd as before; shewing the nature of *History*, which is the immediate representation of things past; and by another *Figure* reviewing the *Sun*, *Moon*, *Stars*, &c. and surrounded with several *Beasts*, *Birds*, &c. denoting the generality of things treated of by *History*.

No. VACUUM, Part 1. Chap. 1, 2, 3. fol. 1. The *Author* having proved it in his *Book*, 'tis thus represented by the *Sculpture*, a *Boy* pouring *Liquor* out of one *Vessel* into another, thereby shewing, that as the *Air* which occupied the lower *Vessel* is drove out by the heavier *Element* of *Water*, it immediately enters into, and fills the upper *Vessel*; as also by the blowing up of a *Mine*, the visible effects of the extension and dilatation of *Air*: The *Figures* seeming to discourse, represents *Philosophers*.

SMELLING, Part 2. Chap. 6. fol. 35. Represented by a *Blood-bound* in scent after his *Game*; by a *Woman* smelling to a *Nosegay*; by a *Man* who seems offended at some unpleasing *Smell*; and by a *Woman* in a swoon, supported by two others, and one of them holding a *Box* or *Glass* of some *Scent* to her *Nose*, which seems to recover her: In prospect a *Pack* of *Hounds* in chase of a *Fox*.

SOUND, Part 2. Chap. 7. fol. 38. Represented by several *Musical Instruments* lying on the fore-ground; also by a *Man* ringing a *Bell*, by another sounding a *Trumpet*, by another beating a *Kettle-Drum*, and by a *Woman* tinkling on a *Brass Vessel* to a swarm of *Bees* to hive them, all proper emblems of *Sound*.

OCCULT QUALITIES, Part 2. Chap. 10. fol. 50. Represented by a *Man*, seemingly trembling at the sight of a *Lion*, and hastily running from it; by the terror of a *Sheep* at the sight of a *Wolf*; by the seeming trembling and fear of a *Hen* and *Chickens* at the sight of a *Kite*, and by the hasty flight of a *Dove* from a *Hawk*; all the visible effects of qualities proceeding from a Cause admired, but never known.

THE BEGINNING or INFANCY of the WORLD, Part 3. Chap. 1. fol. 54. Represented by the *Figures* of a *Savage Man*, *Woman* and *Children*, who seem to live in those *Huts* placed in the *Woods*, having several *Animals* about them. The *Primitive Times* supposed to want the conveniencies of *Houses* and *Apparel*, through want of experience.

The SUN, Part 3. Chap. 6. fol. 62. Represented by *Phœbus*, sitting in his *Charriot* in the *Clouds*, drawn by four white *Horses*, for the reasons before given in the description of the *Sun* in *Glory*. The *Figures* on the lower part are representations of several *Men*, *Women* and *Animals*, bathing themselves (as it were) in those brilliant *Rays* proceeding from this warm *Deity*, *Phœbus*, and may teach us how pleasant and joyful it is to live in the *Sunshine* of *Heaven*.

The MOON, Part 3. Chap. 8. fol. 67. Represented by the Goddess *Diana*, she having a *Sovereignty* of this seeming *Ball of Fire*, given her by the *Poets*: At her Back are *Dogs* pursuing a *Stag*, the emblem of *Hunting*, of which she is, by the same *Authority*, Goddess; and underneath is a *Landskip* with *Deer* therein, the *Victims* offered up to her *Divine Recreation*.

The PLANETS, Part 3. Chap. 9. fol. 70. Represented by the *Personal Figures* of those *Heathen Deities* from whom they borrow their *Names*. As *Luna*, *Mercury*, *Venus*, *Apollo*, *Mars*, *Jupiter*, and *Saturn*. The reason for these *Gods* and *Goddesses* being so adorned, are given in the explanation of the *Sculpture*, representing the motion of the *Planets*: The *Child* in *Saturn's* Arms, and which he seems to devour, relates to the *Story* fathered on him by the *Poets*, that as soon as ever his *Celestial Spouse* was brought to Bed, he did eat the *Children*, to prevent their dethroning him of his *Kindom*.

The GLOBE and SPHERE of the Earth and Heavens, Part 4. Chap. 1. fol. 81. Represented by the *Personal Figures* of those two great *Geographers*, *Ptolomy* and *Copernicus*, the one with a pair of *Compasses*, taking seemingly the distances of some places, delineated on the *Globe* of the *Earth*; and the other holding a *Sea-Chart*, having a pair of *Compasses*, and the *Sphere* of the *Heavens* before him: The *Figure* seeming as it were to take an *Observation*, represents the *Learned Tycho*; on the *Table* are *Charts*, &c.

FOUNTAINS and RIVERS, Part 4. Chap. 4. fol. 88. Represented by the *Figure* of *Thame*, being an *Old Man* lying in the *Reeds* or *Osiers*, having an *Oar* in his Right Hand, and leaning his Left Arm on a *Water-Pot*; as also by the *Figure* *Isis*, being a *Woman* sitting on a *Rock*, having also a *Water-Pot*. *Thame* and *Isis* are storied to be *Man* and *Wife*, and stand as *Godfather* and *Godmother* to that most ample River, vulgarly, *Thames*, it bearing the name of both, as *Thamesis*; as also by the *Figure* of a *Nymph* of the *Rivers* and *Fountains*, named *Arethusa*, holding a *Water-Pot* and *Flowers*; and by the *Figure* of a *Young Man* named *Alpheus*, having a *Water-Pot* and *Cornucopia* of *Flowers*, being the *Patron* of *Fountains*. The *Figures* are thus coupled, to shew that the *Friendly Communication* between *Rivers* and *Fountains*, resemble that between *Man* and *Woman*: The *Figure* in the *Sky*, and seeming to press the *Clouds*, is the emblem of *Rain*.

The SEA, Part 4. Chap. 5. fol. 90. Represented by *Neptune*, *God* of the *Sea*, drawn in his *Charriot* by *Sea-Horses*, having his *Trident* in his Hand, being his *wartry Scepter*, the *Hooks* at the ends of it, are to lay hold on his *subject Fishes*, who fail in their *Allegiance*: Behind him are the two *Figures*, holding and seeming to sound through their *Sea-Shells*, are representations of *Tritons*, *Creatures* formed by the *Poets* to serve his floating *Divinity* in the nature of *Trumpeters*. In prospect the *Sea* with *Ships*, &c.

The FIRE, Part 4. Chap. 7. fol. 99. Represented by *Vulcan's Cave*, in which the *Cyclops* (the *Journey-men Blacksmiths* of *Vulcan*) are at work, in making *Thunderbolts* for *Jupiter*, who is placed above in the *Clouds*,

An Explanation of the Sculptures.

Clouds, attended as usually with his *Eagle*, as inspecting the well-making of his *Weapons*; and behind the *Anvil* stands a *Forge of Fire*, with a *Figure* seeming to blow it, which causes that *Smoak* that arises from the *Funnel* placed by *Jupiter*; below the *Cyclops* Feet lie *Breast-plates*, *Helmets*, &c. in some measure emblems of *Fire*, as owning their form and make, to his *Power*.

EARTHQUAKES and SUBTERRANEAN FIRES, Part 4. Chap. 8. fol. 103. Represented by the *Figures* of the four windy Gods, *Boreas*, *Eolus*, *Auster* and *Zephrus*, each with utmost strength blowing into a *Cavity* of the *Earth*, and heaving up of the *Rocks*, which in several places seem to break forth, and thereby throw down *Trees* and *Buildings*: At a distance the *figures* of *Men*, *Women* and *Children* affrighted, and running to avoid being buried in *Graves* of *Nature*, making the *Mountain*, whose top breaths flames of *Fire*, represent *Mount Etna*; these *Convulsions* of *Nature* are thus properly emblematis'd; it being the general Opinion that they are caus'd by *Winds*, being inclosed in some cavities of the *Earth*, who are forced to break the surface to find a passage to their proper center.

The AIR, Part 4. Chap. 11. fol. 108. Represented by *Juno* the Monarchs of this *Element*, with all her *Poetical Equipage* about her, and attended by her four *Handmaids*, *Iris*, *Imber*, *Cometa* and *Rugida*, who all have their *Aerial Employments* under her; as 1st. *Iris* takes care of putting out and taking in the *Rainbow*. 2dly. *Imber* disposeth the *Rain*. 3thly. *Cometa* placeth the *Comets*. And 4thly. *Rugida* distributeth the *Dew*; all which employments are express'd by the emblems that each of them bear.

METALS, Part 5. Chap. 1. fol. 113. Represented by the 7. *Deities*, who according to the *Poets*, patronise the 7. *Metals*; and they are placed in the *Clouds*: That in the midst is *Apollo*, or the *Sun*, holding in his right Hand a *wedge of Gold*, being the *Metal* he is said to produce; on his right Hand sits *Luna*, having a *wedge of Silver* in her Hand, being the *Metal* that owes its being to her proper bounty; that on the left is *Mercury*, arm'd and crown'd; he is said to produce *Quicksilver* by his celeritous Divinity: The four others that appear behind, are likewise said to produce the four other *Metals*; as *Mars*, *Iron*; *Jupiter*, *Venus* and *Saturn*, *Brass*, *Lead* and *Copper*: In the lower part on the ground, are *Directors* and *Diggers* of *Metals*.

The LOADSTONE, Part 5. Chap. 10. fol. 135. Its *Virtues* and *Properties* are demonstrated by the three *Figures* representing three *Philosophers*, one of whom holds a *Knife*, with a *Needle* on the edge; another having the *Compass* before him, and the other holding a *Loadstone* at a distance: The *Figures* of two other *Philosophers* seemingly discoursing of the *magnetick power* of this wonderful *Stone*.

The WINDS, Part 6. Chap. 2. fol. 136. In the *Sculpture*, *Apollo* sitting in the *Clouds*, and pointing to the *God* of the *Winds*, *Eolus*, who sits in the *Clouds* below him, adorned as before, commanding the four *Winds* express'd by the four *Figures* of *Boreas*, *Zephrus*, *Eolus* and *Auster*, with their proper emblems as before, to discharge their Office; their execution of his Commands are visible in the effects of the *Wind* upon the seemingly tost and overwhelm'd *Ships* in the *Sea* below.

The NYMPHS of the Air, emblems of *Clouds*, *Mist*, *Snow*, *Hail*, *Rain*, *Dew*, &c. Part 6. Chap. 3, 4, 5, 6. fol. 139. 1st. Represented by two *Nymphs* of the *Air* in their proper array, young, beautiful and winged, stretching out their *Arms*, as gathering together and dilating the *Mists*. 2ly. The *Nymph Nix*, scattering of *Snow* through a *Sieve*. 3dly. The *Nymph Imber*, pressing the *Clouds* to provide *Rain*. 4thly. The *Figure* of a *Man* scattering small *Hail* out of a *Water-Pot*; and underneath three *Figures*, the middlemost representing *Dew*, the 2d. *Snow*, and the 3d. small *Hail*. In prospect a *Landscape* covered with a cast of each of their Offices to which they are assigned by the *Poets*, and therefore may properly be used in *Sculpture*, it being an attendant of *Painting*, which is *Poema silens*.

STORMS and THUNDER, Part 6. Chap. 7. fol. 147. *Thunder* is represented by *Jupiter*, preparing to cast his noisive Bolts: and the *Storms* by *Eolus*, the *God* of the *Winds*, commanding the four *Heads* who breath out *Storms* in their *Stations*, as *Boreas* in the *North*, *Zephrus* in the *West*, *Auster* in the *South*, and *Eolus* in the *East*: Below is the true emblem of a *Storm*, being *Ships* tost in a rugged *Mountainous Sea*; the *Fires* seeming to blaze on the *Main Yards* of the *Ship* are two *Sea Wills* in the *Wisp*, and made by the *Poets*, tho' not *Gods*, yet *Godlings* of the *Sea*, and *Protectors* of *Seafaring-Men*, and by them named *Cassor* and *Pellux*, the names of two *Brothers*, reported to have been drown'd.

The RAINBOW, Part 6. Chap. 9. fol. 151. A *Rainbow* proper, surmounted by *Iris* the *Goddess* thereof, the *Rays* of the *Sun* darting on it; by which, as we conjecture, it receives those beautiful and various Colours: The *Figures* below, represent *Philosophers* as con-

sulting concerning its *Nature*; and about that *Ignis-Fatuus* which appears in the *Fields* of the *Landscape*; the representation of a *Nymph* or beautiful *Virgin*, placed on the *Rainbow*, took its rise from *fancy*, but since hath been attested for reality by a *Captain* of a *Ship*, who solemnly asserts his having seen it so.

GARDNING, Part 7. Chap. 1. fol. 156. In the *Sculpture*, the 1st. *Figure* is the *Goddess Rea*, *Commandress* of the *Earth*, seated thereon, as her proper *Throne*, having a *Cassidion* her *Head*, and a *Lion* by her *Side*, emblems of her *Strength* and *Power*; next her is *Hebe*, one of *Jupiter's* *Cup-bearers*, pouring out *Wine* on the *Earth*, as the *Tyth* due to her producing it; the next *Vulturna*, who assists the *Flower* in budding; then *Flora*, embracing the *Plantine-Tree*, being consecrated to her, and holding in her *Hand* a *Flower*, being *Goddess* thereof; behind *Rea* is *Virtumnus*, holding one *Fruit*, and eating another; on the left side of the *Tree* is *Nodinus*, holding the *Leaves* as it buds into *Branches*: Next is *Proserpina*, who hath the care of the *Bud* till it is out of the *Earth*; behind *Nodinus* is *Pateles*, holding a *Leaf* in its full perfection: The reason for thus representing *Gardning*, arises from the authority of the *Poets*, who have made all these *Gods* and *Goddesses* concerned in the preservation of those *Vegatables* that adorn it, tho' I suppose they only meant the *Garden* of the *Muses*, in which none but they and their Successors were to be allowed the liberty of walking: In the upper part of the *Sculpture*, are the representations of *Jupiter*, *Juno*, *Saturn*, *Feronia* and *Luna*, in their proper emblems, relating to their several *Empires*, as before discoursed of, and intimates the necessity of the good will of *Heaven*, and temperate seasonable *Weather* to bring the *Fruits* of the *Earth* to perfection.

NATURE of ANIMALS, Part 8. Chap. 1. fol. 175. For *Animals* begot, they are represented by a *Woman* suckling her *Child*, having a *Cradle* standing by her; their *Thirst* represented by a *Cow* drinking; their *Hunger* by a *Deer* grazing; their *Astion* by two little *Dogs* playing; their *Sleep* by a *Cat* sleeping; their *Wakefulness* by a *Cock* sitting on his *Pearch*, and seeming a *Crowing*; their *Sickness* by a *Farrier* bleeding of a *Horse*, and their *Death* by a *Horse* lying dead.

IMAGINATION, Part 9. Chap. 6. fol. 214. Represented by a *Woman* in a seditary posture, having on her *Head* a pair of *Wings*, and a *Coronet* composed of small *Figures*, which *Figures* denote the productive faculty of *Imagination*, and the *Wings* its swiftness: The *Child* standing by the *Figure* of *Imagination*, partly black partly white, denotes the strength of this *Passion*, being able (as by this Example appears) to perform those things, which neither *Human Wisdom*, nor the common way of *Natures* working could effect: The other *Figure* having *Eyes* veiled, and *Wings* on her *Back*, represents what *Women* call *Yonging*, 'tis swift as *Wings* to *Desire*, and blinded to *Reason*.

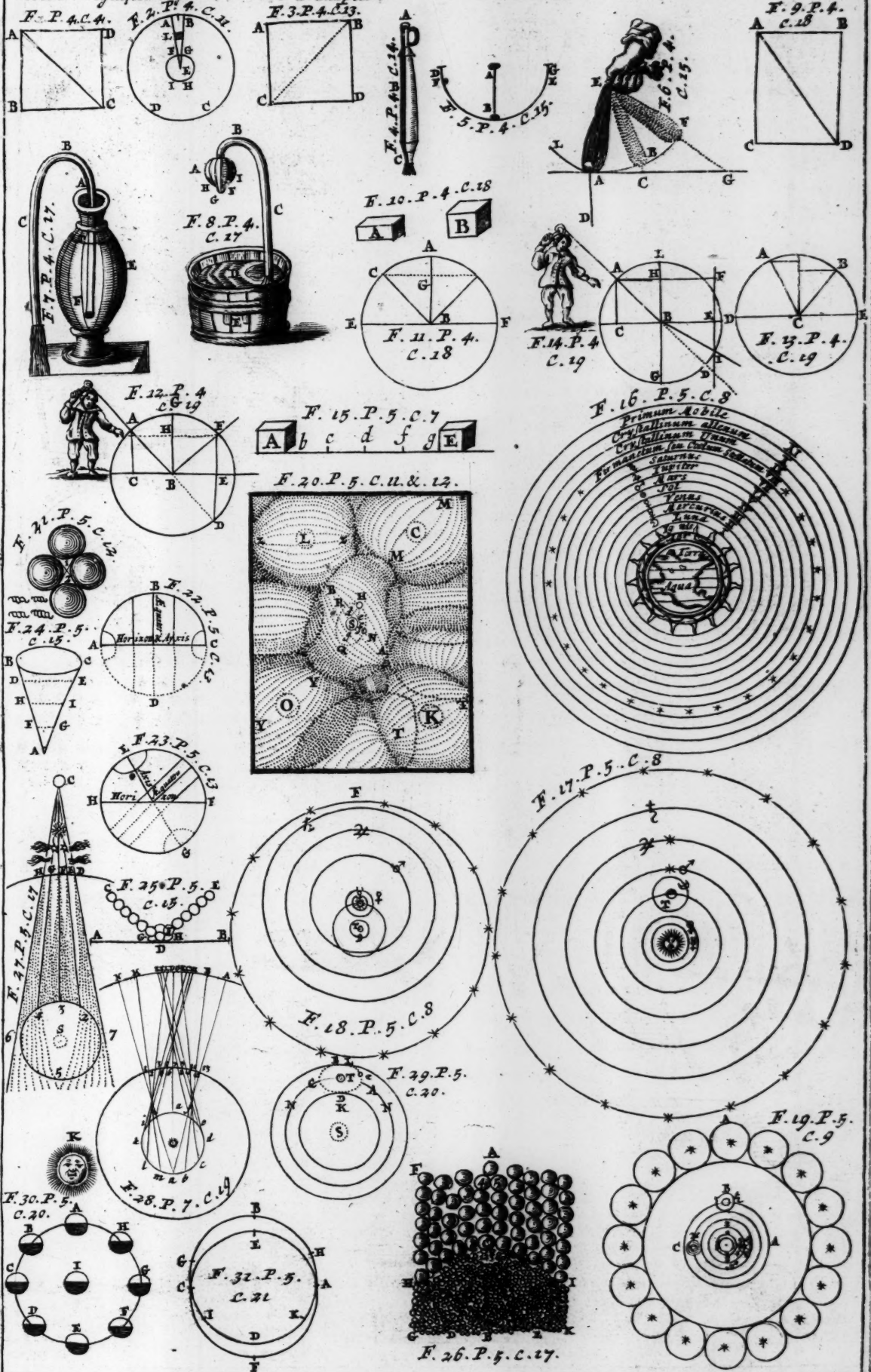
MEMORY, Part 9. Chap. 7. fol. 216. Represented by a *Woman*, having a *Steel Cap* on her *Head*, set with *Jewels*, denoting the *Strength* and *Riches* of this *Faculty*; she is putting her *Finger* to her *Ear*, as the proper *Organ* by which this *Good* is received; and in her *Hand* she holds the *Picture* of a *Man*, whom she knows, tho' absent, by the means of *Memory*; below are the representation of *Children* conning their *Lessons*, and of a *School-Mistress*, who seems awing them with a *Rod*; The *Statue* on *Horseback* is the representation of *King Charles II.* as the properest object to exercise this *Noble Faculty* of *Memory* upon.

The *Author* having asserted in his *Discourse* of the want of *Sense* and *Knowledge* in *Brute Animals*, that they are nothing more than *Machins*, moving in their several *Stations* by *Natures Clockwork*: His ingenious position is illustrated by the *Sculpture* that fronts the said *Traff*. First on the foreground is the *Figure* of a *Woman*, being the representation of *Dedalus* his *Wooden Venus*, which imitated the *Astion* of a *Woman*; next in the midst the *Figure* of a *Man*, being that *Iron Statue*, which presented a *Petition* to the *Emperor* of *Morocco*, as taken notice of in the latter end of that *Authors Preface* to the *Reader*. On the Right Side of this *Figure*, is that of a *Man* with a *Drum*, which artificially beats on it, and at the same time performs several motions with his *Head* and *Eyes*; which *Clockwork* was shewn in *London* not long since. Between these aforesaid three *Figures*, is a *Dial* and a *Dog* sitting, which is another piece of *Clockwork*. At a distance on the second ground, is supposed the *Army* of *Maximilian*, the *Emperour*, over whose *Head* is an *Eagle*, being the representation of the *Norimberg Eagle*, framed by *Athanasius Kirckir*, which flew over his *Head*, and accompanied him in his return to the *City*. Then on a *Hill*, a *Statue* of a *Man*, which saluted the *Sun* at his rising, with a *Hymn Musically* composed: And to conclude, a *Pidgeon* framed by *Archytus* the *Tarentin*, which flew in the *Air* like a living *Bird*; all which the *Author* hath taken notice of, to which I refer the *Reader*.

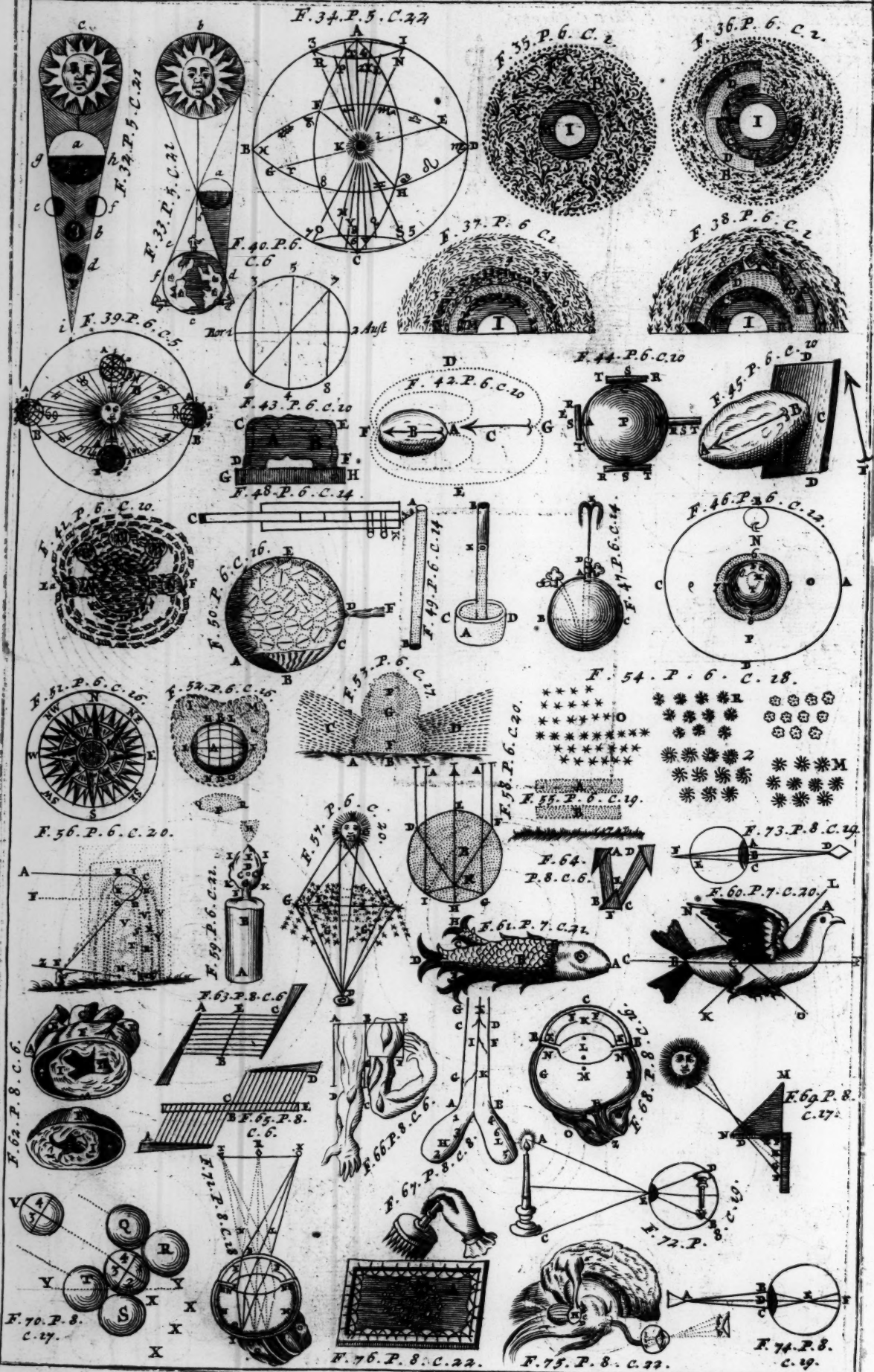
THE

Figures or Schemes in the Institution of Philosophy. Plate 1.

Note F. Signifies Figures P. Part C. Chapter.

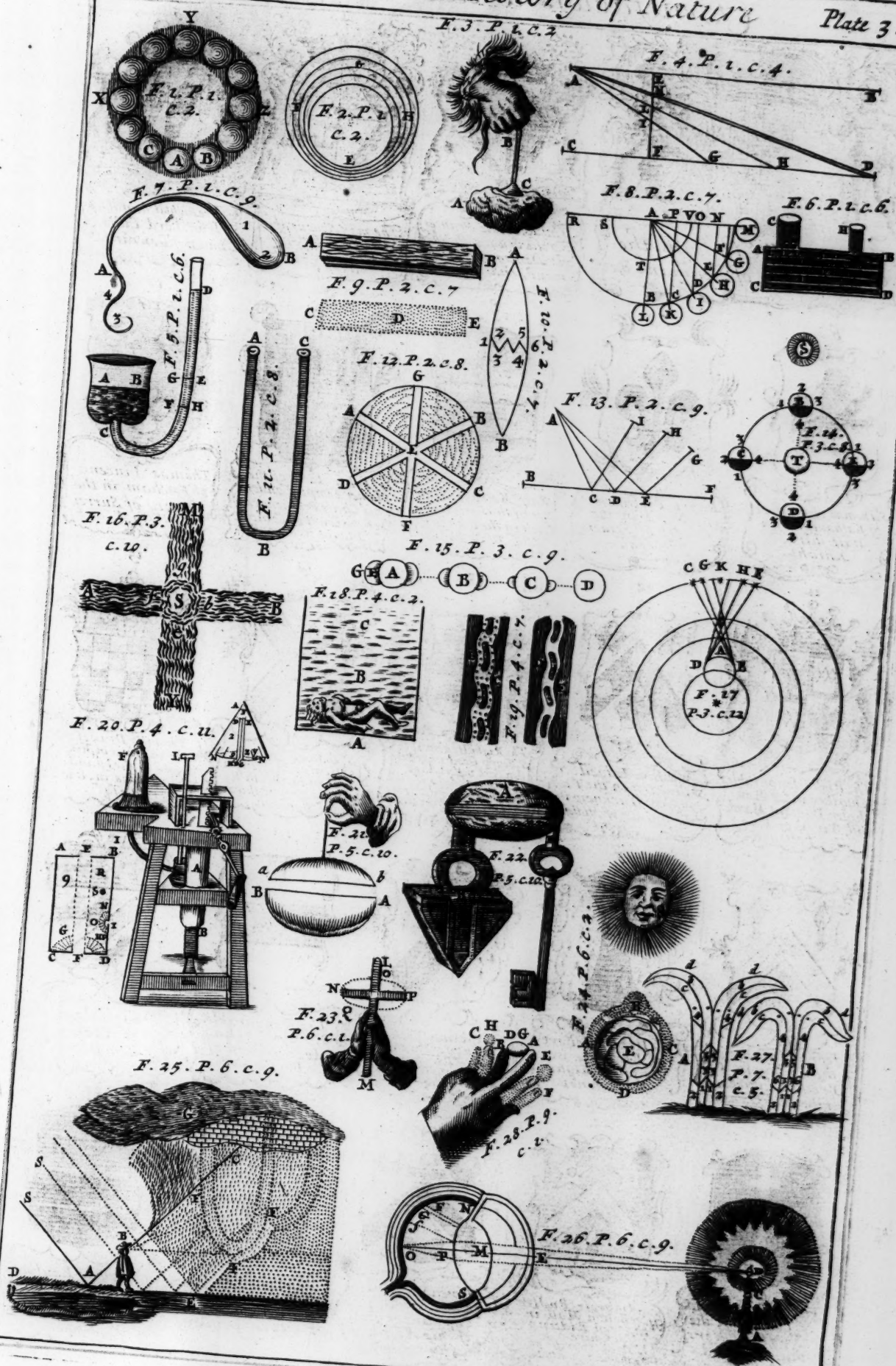


Figures or Schemes in the Institutions of Philosophy. Plate 2



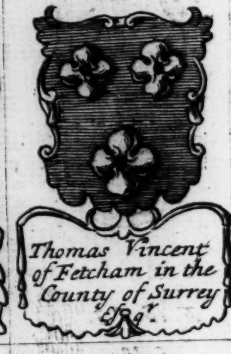
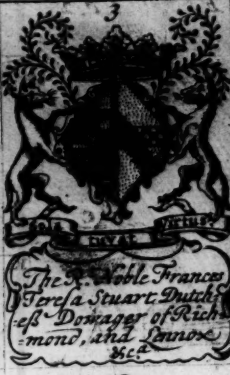
Figures in the History of Nature

Plate 3.




























Benefactors to this Work

folio 1.




























Benefactors to this Work

Folio. 2.

26  The Right Noble Catherine Dutches and Countess of Nor- thumberland Viscountess Palgrave and Barones of Pontefract &c.	27  The Honourable John Granville, Sec- ond Son to the Right Honourable John Earle of Bath &c.	28  S ^r Samuel Gerard of Bragerton hall in the North Riding of Yorkshire Knight.	29  The Right Noble Henry Duke of Beaufort, Marquis of Worcester Baron Herbert of Raglan &c. Knight of the most noble order of the Garter &c.	30  The Right Honourable William Legge Baron of Dartmouth &c.
31  The Right Honourable Francis Viscount Newport, Baron of High Arzall in Shrop- shire &c.	32  The Honourable S ^r William Wogan Knight their Ma- jesty's Sergeant at Law.	33  S ^r John Bolles of Scampton in the County of Lincoln Baronet.	34  William Emmerton of the Middle Temple Esq ^r and examiner in Chancery married to Elizabeth Wife of S ^r John Beale of Barn- ingham in Kent Bar- onet.	35  John Emmerton of the Middle Temple London Esq ^r .
36  S ^r Richard Haddock Knight, Comptroller of their Majesties Navy Royall.	37  S ^r Edmund Turnor of Stoke Rochford in Lincolnshire Knight.	38  Daniel Osborn of the Inner Tem- ple London Esq ^r .	39  William Upton of Lupton in the County of Devon Esq ^r .	40  Andrew Lant of Thorpe-underwood in the County of Northampton Esq ^r .
41  William Benge of Cesely Wood in Wad- herst in the County of Sussex Gentle- man.	42  Anthony Segar of Twyford in the County of South- ampton Gent.	43  John Peeters of the Navy Office in London Gent.	44  William Tempest of the Inner Temple Esq ^r one of the Prothonotaries of their Majesties Court of Common Pleas at Westminster.	45  Captaine Thomas Newnam of Iwer in the County of Buckingham Gent.
46  John Bennett of Graies Inn Esq ^r .	47  Gabriel Armiger of North Creak in Norfolk, and of the Inner Temple Lon- don Esq ^r .	48  Nicholas Hookes of the middle Temple London Esq ^r .	49  The Honourable Ad- mirall Henry Killi- grew, of S ^r Lukes in Hertfordshire.	50  M ^r John Nowell Citizen and Appothecary of London.



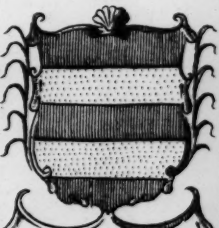

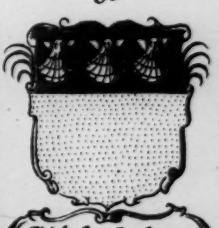

















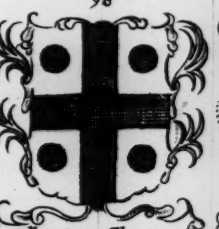

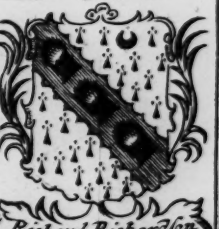
Benefactors to this Work

Folio. 3.

51  The Hon ^{ble} Ralph Delaval of Seaton Delaval in Northumberland Esq. of Gumburnes for receiving the office of High Admiral of England & joint High Admiral of their Ma ^{ties} Fleet	52  S ^t John Wentworth of North Elms-halling W ^{est} Riding of Yorke Shire Baronet	53  S ^t Rowland Gwynne of Lanelbroth in y ^e County of Radnor Knight	54  S ^t Denis Hampson of Lapton in Buckingham Shire & of Bradwell in Oxfordshire Baronet	55  S ^t Barkley Lucy of Netley in Hants Shire Baronet
56  S ^t John Brampton of Screens in y ^e Parish of Roxwell in Essex Knight of the Bath	57  Pheasant Crisp of Crosby Square in London Esq. eldest Son of Samuel Crisp of Chapham in Surrey Esq.	58  William Bridgeman of y ^e City of Westminster Esq. one of y ^e Clerks of their Ma ^{ties} most Honourable Privy Council &c.	59  Francis Forbes of y ^e City of London Gentleman	60  S ^t James Edwards of the City of Yorke Baronet
61  S ^t Solomon Swale of Swale Hall in y ^e North Riding of Yorke Shire Baronet	62  Martin Folkes of Graie Inn in Middlesex Esq.	63  Thomas Phillips of South ampton in Hants Shire Esq. Second Engineer of England 15 th .	64  John Barkley of Stoke in Glocester Shire Esq.	65  John Gilbert of S ^t Martin in the Fields in Middlesex Esq. descended of y ^e Gilberts of Frodley in Stafford Shire
66  Reginald Marriott of y ^e Parish of S ^t Clements Danes in Middlesex Esq.	67  S ^t Christopher Greenwile of Preston in Lancashire Knight	68  Thomas Brotherton of Hey in the County Palatine of Lancaster & of Gray Inn in Middlesex Esq.	69  Francis Sambrooke of the Middle Temple London Gentleman.	70  S ^t William Holford of Welham in the County of Leiceper K ^t descended from y ^e ancient family of y ^e Holords of Holford only
71  S ^t John Morden of Ricklemarshing Parish of Charlton in Kent Baronet.	72  Christopher Parker of Bradkirke in y ^e County of Lancaster Esq.	73  Nathaniel Boothe of Mottram Andrews in Cheshire Esq.	74  Theodore Johnson of y ^e City of London Gentleman.	75  Hallday Milmay of Sharnford in y ^e Parish of Teyford in y ^e County of Southamton Esq.

Benefactors to this Work.

Folio. 4.

<p>76</p>  <p>The R. Hon. Charles Lord Herbert Marquis & Earl of Warrgher, eldest son to his Grace Henry Duke of Beaufort &c.</p>	<p>77</p>  <p>S. John Lereson - Governor of Trencham in Staffordshire Baronet.</p>	<p>78</p>  <p>Simon Harcourt of the Middle Temple London Esq.</p>	<p>79</p>  <p>George London of their Majesties Royall Garden in S. James Parke Garden, Deputy Superintendent and M. Gardiner of their M. Gardens & Plantations in England.</p>	<p>80</p>  <p>Chichester Graham of Wotton Conyers in the North Riding of York-shire Esq.</p>
<p>81</p>  <p>S. William Hocker of Greenwich in Kent and of the City of London R. & L. May, thereof Ans. Dom. 1677.</p>	<p>82</p>  <p>Peter Rycaut of King Stephens Castle in Ospringe in Kent Esq., only Son and heyre of Colonnell Phillip Rycaut, and Nephew to S. Paul Rycaut Knight.</p>	<p>83</p>  <p>Ferdinando Gorges of the City of Westminster Senec. Esq., Grandson of S. Ferdinando Gorges of Ashton Phillips in Somersetshire Knight.</p>	<p>84</p>  <p>The Honourable S. Richard Onslow of Clandon in Surrey Baronet.</p>	<p>85</p>  <p>The Right Honourable John Sheffield, Baronet of Butterwick, Earle of Mulgrave &c.</p>
<p>86</p>  <p>The Right Honourable Henry Lord Viscount Sydney.</p>	<p>87</p>  <p>Captaine William Wallis of S. Martins in the Fields in Middlesex.</p>	<p>88</p>  <p>The Hon. Samuel Pepys of the Inner Temple Esq., Secretary of the Admiralty of England to his Charles, and James the Second.</p>	<p>89</p>  <p>Henry Gorges of Eye in Herefordshire Esq.</p>	<p>90</p>  <p>John Pulteney of the Parish of S. James in Middlesex Esq.</p>
<p>91</p>  <p>The Right Honourable Edward Lord Radcliffe Son and heyre of the Right Honourable Francis Earle of Digswentwater.</p>	<p>92</p>  <p>S. Godfrey Kneller of Lybeck in Saxony and of S. Pauls Church in London Esq., Principal Painter to their Majesties.</p>	<p>93</p>  <p>S. William Thomson of the Middle Temple their M. Sergeant at Law &c.</p>	<p>94</p>  <p>The Right Honourable William Wengrave Esq. of St. Johns Place in London Esq., Baron Wengrave of Wengrave in the County of Northampton and Baronet of Wengrave in the County of Northampton.</p>	<p>95</p>  <p>The Right Honourable Elizabeth Countess Dowager of Winchelsea & Rye, and Baroness of Winchelsea & Rye.</p>
<p>96</p>  <p>John Hervey of Ickworth in the County of Suffolk Esq.</p>	<p>97</p>  <p>Lieutenant Colonnell Andrew Wheeler of Datchet in Buckinghamshire, one of the Captains of their Majesties Regiment of Foot Guards.</p>	<p>98</p>  <p>S. Robert Clayton of Marden in Surrey and of the City of London Knight and Alderman, Lord Mayor 1680.</p>	<p>99</p>  <p>S. Basil Firebrace Knight, Alderman and Sheriff of London Anno Domini 1688.</p>	<p>100</p>  <p>Richard Richardson of the Middle Temple London Esq., one of the City Council for the Sheriffs Court.</p>





To the Right Honourable
of Gowran; Captain
of the Isle of Wight;
Castle; Brigadier
Infanterie in their
and Collonell of a



John Lord Cutts, Baron
Generall and Governour
Constable of Carisbrocke
Generall over all the
Majestyes Service;
Regiment of Foot &c.^a

This Plate is humbly Dedicated by Richard Blome.

The First Part :

OF THE

INSTITUTION

OF

PHILOSOPHY.

CONCERNING

LOGICK.

INTRODUCTION.

CHAP. I.

Of the Nature and Constitution of LOGICK.

I.
What we
are to un-
derstand by
the word
LOGICK.

FOrasmuch as the Mind of Man is obnoxious to many Errors, as well in the searching out of *Truth*, as in the pursuit of that which is *Good*, in both which it is frequently mistaken; two *Arts* have been found necessary, whereof the former might direct the *Will* in the choice of the *True Good*, and the latter assist the *Understanding* in the discovery of *Truth*. The first of these, called *ETHICKS*, is an help to human Infirmary, directing the *Mind* of Man in the prosecution of *Good*, and shewing it what it ought to embrace, and what to avoid; the other called *LOGICK*, is the *Rule* of Man's *Thoughts*, which he is to observe in the framing of them, and by means whereof he may communicate his *Perceptions* and *Judgments* to others.

II.
The Defini-
tion of
Logick.

For *LOGICK* is nothing else, but the *Art* of *right Thinking*, or of *using our Reason aright*; where by the word *Thinking* we do not only understand simple *Idea's* or *Notions*, but also *Judgments* and *Discourses*: For he who *Reasoneth* or *Judgeth*, thinks as well as he, who only attends to simple *Notions*. So that *Logick* extends it self to all kind of *Thoughts*, and gives *Rules* to all the *Actions* of the *Mind*; because *Discoursing*, *Judging* and *Conceiving*, are but so many different *Modes* of *Thinking*.

III.
Why Lo-
gick is
called the
Art of right
Thinking.

It is to be observed, that *LOGICK* is not simply said to be the *Art* of *Thinking*, because *Thinking* is *Natural* to us, and the spontaneous products of our *Mind*; but the *Art* of *Thinking aright*. For since *Thinking* may be performed

well or ill, there is need of an *Art* that may rightly direct the *Actions* of the *Mind*, and prescribe *Rules* for the discerning of *Truth* from *Falshood*. For as the *Art* of *Husbandry* teaches the convenient ordering and disposing of those *Plants*, which otherwise grow of themselves and at random: So *Logick* furnisheth us with *Rules* to define *Things*, to sort them under their *General Heads*, and furnish them with their *Adjuncts*.

Wherefore *LOGICK* may be said to be the *Art* of *Knowing* each *Knowable* that can be the *Object* of Human *Understanding*: Not that it informs the *Mind* of the *Things* themselves, for that is the *Duty* of *Natural Philosophy*; but because it discovers the *Ways* of *right knowing* in general, and delivers those *Rules* by which the *Mind* of Man may be directed, whilst it endeavours to know any thing, so as not to wander from the *Path* of *right Reason*.

Now, that a Man may use *right Reason*, and be able to frame his *Thoughts* aright, and interpret them to others; it is necessary for him to *Perceive aright*, *Judge aright*, *Reason aright*, and *Order aright*.

We are said to *perceive* a thing, when we clearly and distinctly conceive the *Object* offer'd to us: As when we represent to our *Thoughts* *God*, an *Angel*, a *Circle*, a *Triangle*, and stop there, without forming any *Judgment* concerning them. And the *Form*, by the immediate perception whereof we are conscious of our knowing any *Object*, is called an *Idea*.

For by the word *Idea* we are not to understand any *Representations* impress'd upon our *Senses*; but those *Images* of *Things*, which the *Mind* frames by *Thinking*. For the easier apprehension whereof we are to observe, that in the *Idea* or *Notion* of a

IV.
How Lo-
gick assists
the Mind.

V.
Four things
required to
the use of
right Rea-
son.

VI.
First, to
Perceive.

VII.
What we
are to un-
derstand by
the word
Idea, or
Spec. es.

B

Thing

Thing two things are to be consider'd: *First*, That it is a *Modus* inherent in the *Mind*, from whence it proceeds: *The other*, That it shews or represents something. The former of those proceeds from the *Mind*, as its effective Principle; the latter from the *Object*, or thing apprehended, as from its Exemplary cause. So that when we frame the *Species* of any thing by Thinking, that first view of our *Mind*, by which it represents and conceives the Thing as present, is called *Perception*, or in other words, *The first operation of the Mind*, or *Simple Apprehension*. So that this *Perception* is said to be Simple, not with reference to the *Object*, which often is complex (as when the *Sun* is considered as a *Light* or *Lucid Body*;) but with respect to the *Modus*, under which the Thing is conceived.

VIII.
The Second,
to Judge.

We are said to *Judge*, when we affirm or deny any thing of the said known *Objects*; or when we, by the Action of our *Mind* joining two *Idea's*, assert the one to be the other; or deny the one of the other. As when considering the *Idea* of the *Sun* and that of *Fire*, we affirm the *Sun* to be *Fire*, or deny the *Sun* to be *Fire*.

This way of *Thinking* is different from the foregoing, forasmuch as this is not the Simple apprehension of a thing; but a Compound, viz. an *Affirmation* or *Negation*, and is commonly called a *Proposition*, because the *Mind* thereby propounds its Sentiment of Things. It is also called *Judgment*; forasmuch as by this Mode of *Perceiving*, we do not barely apprehend a thing, but also judge or determine what it is, or is not.

IX.
The Third,
to Dis-
course.

To *Reason* or *Discourse* is that Action of our *Mind*, which frames a *Judgment* of many others, or which from two *Propositions*, or from one, infers another: As for Example, After it hath judged that a *Body* is a Substance extended in Length, Breadth and Depth, and that *Heaven* is a *Body*; infers the *Heaven* to consist of three Dimensions.

So likewise observing that the *Idea* of a *Man* agrees with that of an *Animal*, but doth not agree with the *Idea* of a *Plant*, concludes, That therefore neither can the *Idea* of a *Man*, suit with that of a *Plant*. Wherefore finding that *Man* is an *Animal*, and that an *Animal* is not a *Plant*, it infers this Third *Proposition*, that therefore *Man* is not a *Plant*. This way of *Thinking* is call'd *Discourse*, because by running from one *Proposition* to another, it comes to a Third.

X.
The Fourth,
to Order.

To *Order* is an Action of the *Mind*, whereby many things found in the same *Subject*, are disposed in a fit and congruous manner: As when the *Mind*, after it has fram'd several *Idea's*, *Judgments* and *Argumentations*, digests them in the most convenient and fit manner, for the ready and distinct conceiving of them.

XI.
Of what
use the ob-
serving of
these Rules
is.

So that he that would proceed according to *Order*, must begin with those things that are more known, passing on to such as are less; and in the same manner proceed all along from one thing to another, so as that which goes before may always afford light to what follows.

If any one saith, That all these things may be done by the conduct of *Nature* only, since Experience shews, that such Persons sometimes perform them more exactly, who are wholly ignorant of the *Rules* of *Logick*, than they who have studied them: We freely grant as much, nor do we pre-

tend this Art to consist, in prescribing the *Modus* how those *Operations* are to be done, since *Nature* alone is sufficient to make us *Perceive*, *Judge*, *Dis-course* and *Methodize*, without any foreign assistance. Yet is not *Logick* therefore to be judged useless, because it helps us to examine our Actions, and observe those Things which we do by Natural instinct.

As, *First*, that we may be assur'd that we use our *Reason* aright. *Secondly*, That we may with more ease discover the Mistakes, or supply the Defects, that may intervene in our *Mental Operations*. For it oft happens, that by the sole Light of *Nature* we are aware of some *Falshood*, and yet are ignorant where that *Falshood* lurks. As we find that Men ignorant of the Art of *Limning*, are often offended with a Fault they see in a Picture; tho' they cannot make out what properly the Defect is wherewith they are displeased. *Thirdly*, That the *Nature* of our *Mind* may be the more distinctly known by us, whilst we observe and give good heed to those Actions that are proper to it, and which vastly raise it above all Bodily things. Wherefore seeing that the *Mind* suffers it self sometimes to be impos'd upon by false Representations, it has been found necessary to prescribe some *Rules* by which it might be assisted in its Operations, in order to a more certain reaching of *Truth*. And accordingly the whole aim of *Logick* is to inform us, how we ought to make use of our *Reason*, and what Evidence we ought to have, before we give our Assent or Dissent to things, which by *Idea's* are presented to our *Understanding*.

XII.
The Three-
fold use of
Logick.

Whence follows, that *LOGICK* is to be divided into Four Parts, according to the divers Reflections we have of these Four Operations of our *Mind*. The First, concerning *Idea's*, or the simple *Perception* of Things: The Second, of *Judgment*, or of *Propositions*, wherein is *Truth* or *Falshood*: The Third, of *Discourse* or *Syllogism*: The Fourth, of *Method*, or the *Orderly digesting* of our *Thoughts*, by which, as by so many Steps, we arrive to the *Modus* or Way of Knowing. Forasmuch as by the first we are led from *Inconsiderateness* to *Attention*; by the second delivered from *Doubts* and *Errors*; by the third we are accustomed to *Reasoning*; and by the last, we infallibly prove some *Truth*, or demonstratively persuade the same to others.

XIII.
Logick di-
vided into
Four Parts.

CHAP. II.

Of the true Use of *LOGICK*, shewing that *Logick* is useful and necessary to the Conduct of a Rational Life.

LOGICK was always in so great esteem amongst the Ancients, that some of them admir'd it as a thing inspir'd from Heaven, and look'd upon them as rais'd above the Condition of Men, who understood the *Rules* of it, and were dextrous in the practice of them. Wherefore *Cicero* tells us, that the *Contemplation and Knowledge of Nature* is, as it were, by a Wall or Rampart secured and defended by the way of *Reasoning*, by the *Judgment* of what is True or False; and by a kind of Art of knowing what is agreeable and comporting with every thing, and what is contrary to them. And for this Reason the Philosophers of Old

I.
The Opinion
of the An-
cients, con-
cerning
Logick.

Old have bestowed several Names upon it, and measuring the dignity of it by its Necessity; have called it, the *Medicine of the Soul*, the *Organ* or *Instrument of Sciences*, and the *Eye of the Mind*.

II.
The Logick taught in the Schools hath its use.

True it is, that LOGICK seems to have declined from its primitive Majesty, since it now chiefly considers *Forms*, and is in a manner wholly taken up with the Resolving of unprofitable *Questions*: Yet neither is it wholly to be undervalued upon that account, since those *Questions* exercise the Wit of Men, and are not a little conducive to the examining of the Difficulties we meet with in other Sciences. As *Geometricians*, by exercising themselves in the crabbed *Questions* of *Algebra*, which are altogether Abstracted, and of no use for the Conduct of Life, are nevertheless thereby disposed for the understanding of other difficult *Problems*, that are of great use in the Life of Man. In a word, which way soever we consider *Logick*, we shall find it to be of use, and in that regard not inferior to other *Arts* or *Sciences*.

III.
As Physick cures the Body, so Logick does the Mind.

This will be evident, if we consider *Man* in himself, and the *Diseases* he is subject to. For a *Man* consists of *Body* and *Soul*, which both of them have their *Infirmities* and *defects*. So that as *Physick* takes care of the *Body*, by removing *Sicknesses* that afflict it; so there is need of *Science*, that may assist the *Mind*, by dispelling of its *Darkness*. Wherefore *Logick* takes care for the *Soul's* health, and consequently is as necessary to the *Intellectual Life*, as *Physick* is to the *Body*: Nay, and is by so much the more excellent and necessary, by how much the Nobleness of the *Soul* exceeds that of the *Body*, and by how much its *Diseases* are more hidden and more difficult to be cured.

IV.
Why Physicians are more esteemed than Logicians.

Neither is there any great reason of Wonder, why *Physicians* are so much respected every where, and favour'd with Honour and Riches; whereas *Logicians* are commonly very despicable: For the reason of this is, because the *Diseases* of the *Body* do affect the *Soul*; whereas the Disorders of the *Mind* do only afflict it self, and communicate little or nothing of their Smart to the *Body*; whence it happens, that in a manner all Mankind choose to lead an *Animal Life*, and but very few do follow a *Spiritual* or *Mental Life*. To which may be added, that the greatest part of Men are little concerned about the Vices of the *Soul*, and being only intent on the Care of their *Bodies*, think themselves most happy as long as they are in *health*; and all this, because they are drowned in the *flesh*, and wholly addicted to *sense*.

V.
That Nature alone is not sufficient to direct the Operations of the Mind.

It is Notorious, that we brought no *Science* into the World with us, but that the same is acquir'd by *Industry*, or received from *Masters*: But seeing there are few that are able to Teach us, and that they who undertake it are frequently deceived themselves; we must find out a *Method*, whereby we our selves may correct our Errors, and endeavour to mend our Faults.

VI.
The force of Human Reason.

If you say, that our *Reason* is sufficient for this, whose property it is to know the *Natures* of Things, and to discern *Truth* from *Falshood*. I answer, That indeed *NATURAL LOGICK*, or the very force and strength of *Reason*, which we have by *Nature*, doth not a little conduce to the attaining of *Truth*: For it consults those *Rules* Nature herself has prescribed, and being informed thereby, examines its Operations and Discourses by them.

For to speak truth, we naturally follow almost all those *Rules*, which after long study and great pains taking, *Logicians* have delivered to us; so that *Nature* it self seems to have taught us the *Art of Reasoning*; but yet we find, that she is not sufficient to furnish us with all necessary Knowledge, except she be assisted by *Precepts*, and perfected by *Art*. Who can deny, but that the Faculty of *Painting* is born with *Man*; and yet *Art* is necessary for the right forming of *Images*. All Men are endued by *Nature*, with a power of Speaking and framing of *Words*, which yet will never be reduced to *Art* without Use and Exercise; since it is clear beyond doubt, that should an *Infant* from his Birth be left alone, it would continue *Dumb* all its Life, unless it were taught to Form *Words* and give them their due Sound.

VII.
The Necessity of Logick, proved by Galen.

Thus *Galen* proves the Necessity of *Logick* against *Erasistratus* by this Argument; Either every thing follows from every thing, or not: If you assert the former, then it will follow, that because a *Crow* is black, and a *Swan* white, *Erasistratus* is a Fool and mad; if the latter, then you must grant there is need of *Art*, that may inform us what follows and what not. For we cannot make out that a *Consequence* is right, or a *Demonstration* good, without the assistance of *Logick*.

VIII.
Natural and Artificial Logick.

LOGICK therefore is to be distinguish'd into *Natural* and *Artificial*. *Natural Logick* is that force of the *Mind*, by which it rangeth its *Thoughts* and reduceth them to order, or else Discourseth spontaneously without observing any order. *Artificial Logick* is that which is acquired by Use and Practice, and at first took its rise, and increase afterwards from various Observations taken from the Actions of the *Mind*.

IX.
The Use of Artificial Logick.

Wherefore tho' we bring *Natural Reason* along with us into the World, yet is not that sufficient to direct the Actions of our *Minds*: For we find that notwithstanding the Use of *Reason* we fall into many Errors, and labour under the Prejudices of Infancy; and therefore must conclude, that *Artificial Logick* is not only useful, but necessary to cure the Diseases of the *Soul*, and to direct and guide its Operations: Whereby the *Soul's* Diseases, I do not mean *Sins* and *Moral delinquencies*, the Cure whereof is endeavoured by *Divines* and *Moralists*; but the Weakness of our *Mind* in the Perceiving of Things; viz. all manner of Errors, Confusions and Obscurities of our Conceptions; False and uncertain Judgments, and undue Consequences in our Reasonings, the discerning and removing whereof is the whole business of *Logick*.

X.
Doctrinal and Practical Logick.

There is another common Division of LOGICK into *Doctrinal* and *Practical*. *Doctrinal Logick* is that which delivers the several *Rules*, directing us in Perceiving, Judging and Reasoning. *Practical*, is that which applies those *Rules* to Use and Practice: For which reason the Ancients called the former *Abstracted* or *Separate from Things*; but this latter, *Concrete* or *joyned to the Things* themselves we are discoursing of.

The

The First Part.

Of the Clear and Distinct Perception of the Mind.

Seeing it is evident from the foregoing Discourse, that there are Four Parts of LOGICK, correspondent to as many distinct Operations of the Soul, about every knowable Object: We will here begin with the First Part of it, which directs the simple Perceptions and Apprehensions of our Mind. And to perform this the more effectually, we will endeavour to take out of the way the several Hindrances of Science.

CHAP. I.

What the Hindrances of Science are, and how to be removed.

I.
The chief
Causes of
our Mi-
stakes.

There are Two things by which we are easily led aside into the By-way of Error and Falseness, viz. *Prejudice*, which makes us take up any thing for *Truth*, before *sound Reason* hath convinced us of it; and *Slavishness*, by which we are so addicted to the Opinions of others, that we think it a Crime to differ from them.

II.
We are
very sub-
ject to be
seduced by
the Preju-
dices of
Infancy.

Wherefore it is no wonder that we find so few Men truly Wise, and who know the Causes of Things aright, seeing they scarce consider any Thing well and duly throughout their whole Life, and do not so much give their assent to Right Reason, as to their *Prejudices* and the Testimony of their *Senses*. For the force of *Prejudices* is so prevalent with some, that they cannot admit any thing for *Truth*, which is not grounded on those false Opinions they have suck'd in from their *Cradles*. Wherefore it will be worth our while to shew, how vain the Things are we then know, and that we ought to distrust and suspect whatsoever proceeds from such weak Causes. For what did ever any *Infants* perceive, which they did not wholly refer to their *Bodies*, and which they did not desire or dread, according as they fancied them hurtful or grateful to the same? Thus we see they are pleas'd with the Light and Shining things, because *Refulgency* with its Beauty pleaseth their Eyes; whereas they dread a *Rod*, because with it they are chastis'd and put to pain. Wherefore *Children* judge of things, as they appear to their *Senses*; As that the *Earth* is far bigger than the *Sun*, and the rest of the Heavenly Bodies; because the *Earth* is nearer to them, the other being at a great distance from them. Thus likewise they think, that there is more Matter in *Lead* and other Metals, than there is in *Fire* or *Air*; because they find more Weight and Hardness in the one than the other. And again, because they perceive no more Brightness from the fix'd Stars than from the small Light of a *Candle*, they are apt to think that the Stars do not exceed the bigness of a *Candle*, and therefore fancy them as so many bright and shining *Studs* fix'd in the Firmament of *Heaven*; whereas there is no *Natural Philosopher* but knows, that the fix'd Stars are equal to the *Sun* both in Bigness and Brightness.

III.
The Preju-
dices of
Childhood
hinder us
after we

Now these Errors are not only to be found in *Infancy*, but in process of Time they get strength, and become so rooted into *Mens Minds*, that they accompany them the whole course of their Lives. Hence it is that we meet with some that have the

Gravity of *Old Age*, but at the same time are subject to the Weakness of *Children*. Which Mistakes arise from hence, because they suppose that the Opinions they have taken in during their *Childhood* and *Youth*, are inborn *Norions*, and common to all Mankind. Whereas they ought to consider, that they have admitted many things for *Truth*, without any sufficient Examination, and that therefore they ought rather to think them to be false than true. But the case is the same with them, as with those that have Sore-Eyes, who delight in *Darkness* and are offended with the *Light*; for they hug their *Errors*, and are loath to part with them.

Some of the *Philosophers* of Old were not free from this Weakness, who asserted the *Sun* not to be above two Foot over, because they had never seen it greater. And it was to no purpose to persuade them by *Astronomical Arguments*, that it was not only far greater than so, but many times bigger than the *Earth*; because their preconceived Opinion was so rooted in them, that they could no otherwise apprehend it. Thus likewise when they were *Children*, and thought of nothing but what was Bodily, they thought nothing could be Corporeal, but what must be Sensible also, from which *Prejudice* they concluded afterwards, that there could be no *Insensible parts*. If one argues against this, that such Parts must of necessity be admitted to avoid a *Vacuum* in Nature, and for the Explication of many *Natural Appearances*; they have nothing else to answer, but that they cannot see them, and that they are not certain of any thing, except it fall under their *Senses*. From the same *Prejudice* it is, that they conceive all *Immaterial things* after the manner of things Sensible, and apprehend the *Mind of Man*, not as a *Thinking Being*, void of all Matter, but like a *Wind* or *Fire* infus'd into the Groffer parts of the *Body*, to which tho' they attribute the Name of *Spirit*, yet conceive of it under a Bodily likeness. Wherefore also they greedily embrace that Maxim of *Aristotle*, That there is nothing in the Understanding, which was not first in the *Senses*.

IV.
Some only
give cre-
dit to the
report of
their
Senses.

If we go further and tell these Men, That *God* doth not fall under any of our *Senses*, and therefore cannot be conceiv'd of under any sensible Form; yet by reason of their Inveterate Custom of false Judging, they rather chuse to frame several Distinctions, than to forsake their beloved Maxim, tho' only supported by *Childish Prejudices*; saying, That *God* is made manifest unto us by his Effects, or by some Signs, as by his Creatures and Words that signify his Nature unto us. Which *Prejudices* do really divert the *Mind* from the knowledge of Things, and hinder it from ever attaining the true way of *Philosophizing*. For how can we think ever to attain it, if we always Judge after the manner of *Children*, and only believe those Things to be true, which through the *Senses* are convey'd to us? How can we ever think to make a right use of our Reason, if we only take those things to be good which are of Profit to us? If we think the *Air*, *Cold* and *Heat* to be nothing, when they do not sensibly affect us? Or, if we judge the *World* to end where our Sight is bounded, and innumerable other Things, which the Love of Antiquity, or the Authority of some Men have induced us to maintain.

V.
And there-
fore assert,
that *God*
cannot be
known but
by sensible
things.

Now



G. Freeman Inv.

I. Kip Sculp.

To the Right Honourable
Dartmouth &c. son of the
Lord Dartmouth, Master
Master of the Horse,
fleet of ships, and one
most Honourable.
This Plate is humbly



William Legge Baron of
Right Honourable George
Generall of the Ordnance,
Admirall of his Majestys
of the Lords of his Majestys
Privy Councell &c.
Dedicated by Richard Blome



To the Worship- full John Emmerton
of the Middle Temple London Esqrs.
(This Plate is humbly Dedicated by Richard Blome.



VI.
Education
and Cu-
stom lead
us into
Error.

Now all these *Prejudices* are much increased, by those Words which are in common use, and which the illiterate Multitude hath imposed; as having more reference to the Use of the *Body*, than to the Contemplation of Things. Moreover *Education*, *Custom*, and *Converse* with other Men, the *Authority* of those we reverence, the *Consent* of Mankind, and many other such like, hinder us from scanning of Things purely and sincerely, and lead us into many Errors. What hath once been prov'd to us, or believed by us, we scarcely ever reject, insomuch that the *Vices* and *Affections* of our Will, do communicate their contagion to our Mind and Understanding.

VII.
Hard and
difficult
things are
apt to
please us
more than
things
easy and
obvious.

Sometimes it happens on the contrary, that those Things which are clear and perspicuous of themselves, are suspected by us; because Things obscure and liable to dispute do more affect us. Thus we are apt to condemn Experiments, as being too despicable, and our *Mind* desirous to take a higher flight, and hating to be confin'd to the narrow bounds of an *Experiment*, chooseth rather to please it self with some General Notions, which for the most part are of no use at all; and so prefer swelling Words of Vanity, which fill the Fancy, before things real and solid. Hence it is, that the High-flown Expressions of the *Platonists* and *Chymists* do allure so many. Besides, we are apt to suffer our selves to be deceived by the respect we have for *Antiquity* as well as by our affectation of *Novelty*, as if a thing were therefore true, because it is either New or Old, as if True things had not always been so, as if in this old Age of the *World* we might not expect the discovery of many Things heretofore unknown, or as if we might not look for a riper Judgment, and more knowledge from Old Men, that daily Experience many things, than from others.

VIII.
We must
first exa-
min our
Opinions,
before we
lend an
assent to
them.

We are therefore to examine our *Opinions* by the Standard of *Reason*, before we give our assent to them; and must judge those things to be True, not which the *Authority* of the Ancients, or the Judgment of most Men doth approve, but which are evidenc'd to be so by the strength of *Reason*. For the obtaining of which the following *Rules* will be helpful to us, if we seriously mind them, and judge of Things propos'd to us, according to their direction.

CHAP. II.

Some Rules for the Attainment of Truth.

The First Rule.

We are to admit of nothing that involves any thing of Doubtfulness.

I.
Doubts hin-
der us from
the attain-
ing of
Truth.

THE Light of *Nature* assures us, that *Doubting* is an obstacle to *Science*; and that we can never attain it, as long as the thing we apprehend is not clearly and distinctly represented to our *Mind*. Wherefore we shall do well to esteem all *Doubtful Matters*, as if they were false, and despise them as hurtful *Images*, that are apt to lead us into Error. For seeing that all Things that are built on any *Principle*, derive all their Certainty from the same; if that *Principle* be weak and tottering, the superstructure must partake of the same Conditions.

II.
We must
not thus be
too scrupu-
lous.

But tho' this *Rule* be of use for the clear knowing of Things, yet must we not extend the same to Human Prudence, or the use of Common Life.

For it often happens, that we are forced to embrace what is least suspected; and to esteem that as Good, which doth least hurt another. Thus the Laws wink at the Toleration of *Whores*, to prevent the greater Evils of *Rapes* and *Adultery*. Thus in Human Actions we are forc'd to choose that which seems probable, and to leave that which is more true. But in the Search of *Truth*, whatsoever hath the least Doubt in it, is to be rejected, and is no more to be regarded than if it were a thing feigned at pleasure. For whatsoever doth not conduce to the attaining of *Truth*, must be look'd upon as a straying from it.

Wherefore he that would *Philosophize* in good earnest, must rid himself of all the *Prejudices* of his Infancy, forasmuch as they have crept into our *Minds*, without any foregoing Examination of *Reason*; and therefore are to be consider'd by us, as false, rather than doubtful. Hence it is that our *Philosopher* saith, I have now for some years consider'd how many false things from my first Childhood, I have taken up for True; and how uncertain and doubtful all those things are I have built upon them; and therefore that it were best once in my life to overthrow them all; and to begin again from the first Foundations, if ever I would desire to establish any thing in *Sciences* that might be firm and lasting.

III.
The reje-
cting of
things
Doubtful,
is a help
to the at-
tainment
of Science.

Neither need we to fear, left by taking all things for false, we should be in danger of being deceived; because this *Doubting* is only indulg'd for to attain to greater certainty, and that we may the more evidently distinguish *Falshood* from *Truth*. For whatsoever includes the least Doubt, destroys *Science*, as hath been said, and leads to *Error* as well as *Falshood* it self. Is it not lawful for the *Philosophers* to suppose many Things, that by this means they may find out what is most certain and easiest to be known? Thus the *Astronomers* imagin an *Aequator*, a *Zodiack*, and other *Circles* in the Heavens, that by the help thereof they may the more accurately describe the *Sun's Course*. *Geometricians* also make use of the like Suppositions, when with new *Points* they measure *Lines*, and to the *Figures* given add other *Lines*. Wherefore it will be of advantage to those who search after *Truth*, to reject all things that occur to them, and to give their assent to those things only, which they understand to be Certain and Evident.

IV.
There is no
danger in
this Doubt-
ing of
things.

This way of Proceeding in the attainment of *Sciences* is not peculiar to *Descartes*, for *Aristotle* himself hath followed the same, as may be seen in the First Chapter of his Third Book of *Metaphysics*, which bears this Title; Of the Usefulness of *Doubting*, and what things we ought first to doubt of: Where he speaks thus; In order to our attaining the *Science* we desire, it is in the first place needful to take a view of those things we are first to doubt of; now such are all those things about which Men are divided in their Opinions, with other things besides. It being an Industry well worthy the pains of those who desire Knowledge, to Doubt aright. Wherefore we need not think strange, that our *Philosopher* begins his *Philosophy* with *Dubitation*, and requires us to reject all those Opinions wherein we meet with the least cause of *Doubting*, that by this means we may at last find out a true and unshaken *Principle*.

V.
The way
of Doubt-
ing appro-
ved by
Aristotle.

C

The

The Second Rule of Truth.

We are not to rely too much on our Senses.

I.
The Senses
are subject
to mistake
on several
accounts:
As,

Forasmuch as our *Senses* are deceivable, and we are frequently imposed on by them, Common Reason will tell us, that we must not overmuch trust to them, but rather suspect whatsoever they offer to us; for it is a sign of *Rashness* and *Imprudence*, to trust them that have once deceived us. Now how apt our *Senses* are to deceive us, daily Experience teacheth. For it happens often, and for divers Reasons, that things appear otherwise to our *Senses* than they are indeed.

First, By reason of their *Distance*, as when the Object is so far from us, that all the *Reflex Rays* proceeding from it, cannot whole and entire reach us: As for Example, The *Sun*, and a *Square Tower* at a distance seem less, and otherwise figured than indeed they are.

Secondly, By reason of the *Medium*, as when the *Rays* are variously refracted in the same: Thus a *Stick* and other Bodies seen through the *Water*, appear Crooked.

Thirdly, By reason of the *Surface*, which as it appears to the *Senses*, doth not represent the Essential position of the Parts of the *Body* whose Surface it is: Thus the outside or superficies of a *Bean*, which falls under our *Senses*, represents a Figure very unlike that of a *Plant*; whereas the *Microscope* discovers to us, That it hath the same Essential disposition of Parts with the whole *Plant*, whose Seed it is. So likewise the *Spawn* of *Frogs* appears to our Eye, to be an Unorganical Mass; whereas the said *Magnifying Glasses* assure us, that they are distinguish'd into several Members. And the same may be proved by many more Instances. Neither is it to be doubted, but that there be many *Bodies*; the Essential Constitution of whose Parts were never yet discovered to us by any of our *Senses*, which if they were, we should judge otherwise of them, than the *Vulgar* do.

Fourthly, By reason of the *Impression* made upon our *Senses*, when the *Vibration* (caus'd by the Object) doth for some time continue; As when the *Sun* appears to our Eye after it is shut; or as when a *Torch* is with great swiftness turn'd round, whereby a fiery Circle is represented to the Eye, tho' the *Torch* be not in all the Points of the *Circle*.

Or when the *Impression* proceeds from something else besides the Objects; as in *Dreams* and strong *Imaginations*, &c. or when an Angel (by moving the Organ of *Sight*) doth represent himself to us.

II.
This Rule
is not to be
extended
to the
Actions of
Life.

Which deception doth not only frequently happen to our *External Senses*, but even our *Internal Sense* is not free from it. Thus we see, that those who are troubled with the *Vertigo*, think that all the Bodies about them turn round, and suppose the Air to be darkned: Thus likewise *Drunken Men* see all things double. Now when it is said, that we are not to trust the Testimony of our *Senses*, but are to look upon them as if they were false; we are to observe that this Rule must not be transferr'd by us to the *Actions* of *Life*. For it is contrary to Reason, not to trust our *Senses* in the conduct of our *Lives*: For by this means we shall make our selves guilty of the Folly of those *Scepticks*, who out of a foolish distrust of their *Senses* were ready to expose themselves to eminent danger of their *Lives*,

but that their Friends hindred them. Tho' indeed, when the Question is about the bare knowledge of Things, then it is on the other hand every whit as Irrational, not to reject whatsoever is in the least doubtful, because things that are so, are as oppositely to the attaining of *Science*, as those which are altogether false or unknown.

And tho' our *Senses* sometimes may represent to us Things as they are, yet must not this hinder us from suspecting their Evidence: For having once deceiv'd us, they may always deceive us; or how can we rely upon them, which have once led us into Error? And therefore *Plato* in his *Phædrus* tells us, That Men who are desirous of *Science*, know, that Philosophy having once undertaken the Care of their Mind, does by little and little inform it, and loose it of its Bands; representing to it, how deceiving the Judgment of the Eyes, Ears, and other Senses are, persuading it to leave them, as far as absolute Necessity does not oblige us to close with them, and to recall it self, and to recollect within it self, without giving credit to any thing besides it self.

For our *Senses* are not given us by Nature for the searching out of *Truth*, or to contemplate the Principles of Things: Because if we take an exact view of the Objects of *Sciences*, we shall find that most of those things that occur to our Mind, are not represented by any Bodily Figure: As for Example, All the Objects of *Metaphysics* and *Natural Divinity*, which admit nothing of any *Corporeal Form*. For we have in our Mind an *Idea* of *God* himself, whose Authority we believe, and whose Dominion over all we firmly are persuaded of. For how could we demonstrate so many things concerning *God*, if his *Idea* were not inherent in us? But do any of our *Senses* hand this Knowledge of *God* to us? What Phantasm manifests to us the General Notions of *Entity*, *Unity*, *Truth* and *Goodness*? What Species represents to us the *Idea* of *Angels*, or our own *Soul*, since there is nothing like them in the whole Universe of *Material Beings*, and with which they have not any thing in common, save only the Name of *Substance*? Wherefore it is very absurd to go about to derive all Knowledge and *Idea's* from the *Senses*. And if from these we pass to *Physical* or *Natural Beings*, we shall find that not only the Beginning of them are hid from our *Senses*; but that not so much as their Figures are represented to us, such as they are indeed, but very different from what our *Souls* upon enquiry find them to be. Do not we reach the Nature even of those thing that most strongly affect our *Senses*, as *Light*, *Heat* and *Cold*, far better by our *Understanding* than by *Sense*? And are not many times the most sensible Objects the least perceptible to our Intellectual Sight?

The *Senses* therefore are bestowed upon us by Nature to discover to us, who consist of *Soul* and *Body*, what things are good or hurtful for us; and we pervert the order of *Nature* when we put them to another use, and apply them to the knowledge of *Truth*, which are only design'd for the Preservation of the Compound. Wherefore also this may be reckon'd amongst the chief Causes of Error, wherewith we are possess'd from our Childhood, that we are apt to judge of things, not as they are in themselves, but only as they gratifie or offend the *Body*.

III.
Our Senses
having
once deceiv'd
us, are
to be look'd
upon as
always li-
able to de-
ceive us.

IV.
Our Senses
are of no
use, for the
discerning
of the Ob-
jects of
Sciences.

V.
To what
end our
Senses are
given us.

VI.
Objection,
That the
Senses in-
form us of
many
things.

VII.
The Senses
do only
accidental-
ly discover
things to
us.

VIII.
How our
Senses are
said to be
deceitful.

I.
Our Under-
standing is
the searcher
out of
Truth.

II.
Not only
common or
general
Natures,
but parti-
lar also,
are known
by the Un-
derstand-
ing.

If any one object, That we attain to the know-
ledge of many Things by our *Senses*; that by our
Feeling we perceive Bodies, as *Stones, Wood* and
other things that come within the reach of our
Hands; by our *Sight*, things at a distance, as the
Sun, Moon, Stars, Heaven, &c. and that without
them we could never have any knowledge of these
Objects.

To this I answer, that I do not wholly reject
the Service of the Senses; but only assert, that they
are insufficient and inadequate for the knowledge of
Truth. For tho' the *Senses* may inform us that
Bodies exist; yet cannot they discover to us what
those *Bodies* are, or what their Nature and Essence
is; because this is not necessary for the Conserva-
tion of the Compound. And if ever they inform
us what they are in themselves, this is only some-
times and by accident. For seeing that our *Senses*
cannot perceive Corporeal things but through the
intervening *Medium*, it is evident, that according as
that is variously disposed, so their Judgment con-
cerning them must vary accordingly. Thus we
see that for this Reason the *Stars* appear to us of
various Colours, sometimes more red, and sometimes
paler, according as the *Air* that comes between our
Sight and them is clearer or thicker. And therefore,
as *Lucretius* saith, *Lib. 4. we have great reason to*
suspect, that the Inferences we fetch from our fal-
lible Senses, must be false and deceivable.

But when we say, that our *Senses* are deceitful
or subject to Mistake; we must not so understand
this, as if there were an Error in the *Motion* itself,
or in the affecting of the *Corporeal Organ*, because
that is done by a kind of Natural Necessity; but
because the *Mind* of Man, by reason of its inti-
mate Union with the *Body*, doth from that Affection
or Motion take occasion, to apprehend or judge of
the thing amiss. And forasmuch as this precipi-
tancy and inconsiderateness in Judging is commonly
attributed to the *Senses*, and not to the *Mind*, the
Senses are said to deceive us, because our *Judg-*
ments follow those Perceptions that are attributed
to our *Senses*.

The Third Rule of Truth.

*Whatsoever we Perceive, we perceive with our
Minds.*

Forasmuch as *Divine Revelation*, or *Human*
Tradition, have no admittance in *Philosophy*, and
that according to the fore-going Rule, we are to
suspect whatsoever comes from the *Senses*; it re-
mains that the *Understanding* alone must be the
sole searcher out of *Truth*, whose property it is to
investigate the Natures of Things, and so judge of
them according to the Attributes that are found in
them.

Neither is this only to be understood concerning
Essences, or *Abstract Natures*, as the *Metaphysicians*
call them; but of every particular Object that
strikes our Senses. For it is the *Mind* alone which
sees, hears and feels through the Organs. For *Gold*,
by Example, that is newly dug out of the Mine,
doth at first sight look like Earth, and before Coa-
gulation is more like Sand, than a Metal: But
after it is once cast into the Furnace, it loseth the
form of Earth, its parts run together and shine like
a Star; and what before lookt so much like Dirt,
now delights and pleaseth all Men. So that my
Senses at first perceived nothing of the Nature of

Gold; for whatsoever my Sight or Touch before
discovered of it, is quite changed, the substance of
Gold still remaining.

Wherefore it is the *Mind* alone that knows the
Nature of *Gold*, neither can we discern what it is,
but by our Faculty of *Judgment*. We make no
scruple to say, we see a *Man*, when we see one
walking in the Market, tho' indeed we see nothing
but his Cloaths, under which possibly a meer Ma-
chin might be conceal'd. It is plain therefore, that
we do not make this Judgment by our outward
Eyes, but by our Faculty of *Judging*, which is
Internal.

To explain this by another Example; Our *Skin*
appears to us to be a continuous Body, without any
Holes in it that our Eyes can perceive; but yet our
Mind, by the Transpiring Sweat, concludes there
must be Pores in it, by this way of Reasoning:
The Moisture that is sent forth through my Skin, is
a Body; now a Body cannot pass from one place to
another without passing through a Medium; where-
fore it must follow that my Skin is like a Sieve or
Strainer; that is, of such a Texture, as to be full
of little Holes, through which the Moisture may
pass.

This Rule is so certain, that whosoever denies it
will never be able to attain any thing distinctly or
by Reflex knowledge, which is necessary to Science.
And though some relying upon *Aristotle*, suppose
all our *Idea's* to arise from our Senses, and that
there is nothing in our Understanding, which was not
first entertain'd in our Senses; yet it is evident, that
this Opinion, tho' common, is directly opposite to
Divinity and true *Philosophy*. For first, there is
nothing we perceive so distinctly as our *Thoughts*,
neither is there any Proposition that shews it self to
our *Mind* with fuller Evidence than this, *I think*
therefore I am; and yet neither of these *Idea's* of
Cogitation, or *Being*, were ever discover'd to us
by any Sense: Not by our *Sight* or *Hearing*, as
being without Colour or Sound; nor by any other
of the Senses, because they have no Sensible qua-
lities, or if they think they have, let them declare
them. But if they cannot satisfy us herein, what
remains but for them to own our Assertion, That
the Notions of *Thinking* and *Being* do not depend
on the Senses, but that our *Mind* forms them by its
own proper virtue or efficacy; tho' we do not deny
but the *Mind* may be sometime excited to the
forming of them by outward things that affect our
Senses.

Who can believe that the *Idea* of *GOD*, which
is in us, doth proceed from our Senses? Or shall
we think so, because some Ignorant persons conceive
him under the form of a *Venerable Old Man*, as
Gassendus tells us. But this is to confound and de-
prave *Idea's*, when we go about to imagin Spiritual
things under a Bodily form: And he is in as great
a Mistake, who would imagin Immaterial Substances
as he is, who would hear Colours and see Sounds.
It is apparently false therefore, that the Notions
which we have of Spiritual things do proceed from
the Senses; nay, what is more, it is certain that no
Representations of Material things come to our
Mind, save only occasionally; that is, forasmuch as
the *Motions* made in our *Brains* (for nothing but
Motions can affect our Senses) do give the *Soul* occa-
sion of forming several Notions, which without
them it would not do. Which *Notions* are also
wholly

III.
Tis by the
Mind alone
we know
Objects.

IV.
It is by our
Under-
standing
alone we
know that
there are
Pores in
our Body.

V.
Many
things
cannot be
discovered
to us by our
Senses.

VI.
GOD can-
not be re-
presented
by any out-
ward Ap-
pearance.

wholly distinct from those Motions and Representations, which are in the *Brain* or *Senses*. For they who are *Blind* and *Deaf*, tho' they receive no Species or Sounds from the *Objects*, yet are not without the *Idea's* of *Cogitations*, especially when they reflect upon the things they are thinking of.

VII.
How the
Idea of Im-
material
things are
said to be
inborn in
us.

Wherefore seeing we can perceive nothing by our *Sense* or *Imagination* but what is *Material*, it follows that the *Idea's* of all other things that are not *Material*, are inborn with us; for by what other means could they be convey'd to our *Minds*? Yet when I assert that these *Notions* were put into the *Mind* in its first beginning, I would not be so understood, as if they did actually exist there, and were continually obvious to our *Thoughts*; but only that God hath vouchsafed a Faculty to our *Mind*, of exciting and producing such *Notions*; as shall be more largely treated in the *Ninth Part*, concerning the *Mind of Man*.

The Fourth Rule of Truth.

That is True which we know clearly and distinctly.

I.
Cogitation
is the Rule
of Truth.

Wherefore there can be no more certain Rule of *Truth* than our *Cogitation*, so that the same be but distinct and clear, and without the least Doubtfulness; because it is impossible for us to mistake, as long as the *Judgments* we frame of any thing do correspond to our *Perceptions*. It being an undoubted Axiom with us, *That our Knowing of a thing is a sure Argument of its Essence*. Not as if because we perceive the *Essence* of any thing, that from thence we should presently conclude that it exists: But because it is impossible that any thing which is clearly known by us, should not be such as it is known by us; that is, the thing must exist, if its *Existence* be perceived by us, or must be of this or the other Nature, if its Nature be represented to our *Mind*.

II.
From this
Principle
the Exi-
stence of
GOD is
proved.

From this Principle *Descartes* evidently demonstrates the *Existence* of *GOD*. For if upon the account only (saith he) that I have such an *Idea* in my *Mind*, it doth follow that whatsoever I perceive clearly and distinctly to belong to it, doth really do so; may I not from hence fetch an Argument for the *Existence* of God? Yes surely: For the *Idea* of *GOD*, represents a Being absolutely Perfect: Now it is every whit as repugnant to a Being absolutely Perfect, to want any Perfection, as for Example, *Existence*, as it is for a Triangle not to have three Angles equal to two right ones.

III.
Provided
it be clear
and dis-
tinct.

I said in the Beginning, provided our *Cogitation* be clear and distinct; because no Certainty can be expected from a thing, whose Knowledge involves the least degree of Obscurity or Confusion. And therefore *Plato* in his *Timæus* tells us, *That when we discourse of a firm, stable, and intelligible thing, our Reasons also must be stable, immutable, and insuperable*. For seeing that clear and distinct Knowledge is something which we our selves are not the Authors of, it must follow that *GOD* is the Author of the Connexion there is between clear and distinct Knowledge; and the assent which the *Will* infallibly yields to it. So that it is absolutely impossible, that what I thus apprehend to be true, should be false: As for Example, When I perceive *Two and Four to be Six; that in a Triangle there*

be three Angles equal to two Right ones; and the like. It is impossible these should be false; not because they are so conceived by me, but because except they were true, I could never have clearly or distinctly perceiv'd them.

For if any thing thus apprehended by me could be false, this would destroy all Human Knowledge; neither could any of us be sure of any *Truth*, nor of the *Existence* of *God*, nor of any of those things which are related to us in Holy Writ: Since it might still be objected to us, that those very things may be false which we most clearly and distinctly perceive.

IV.
It is im-
possible that
what we
clearly and
distinctly
perceive
should be
false.

But we cannot attain the same certainty of Knowledge in those things which are only perceived by the *Senses*, forasmuch as they are liable to Mistake: As when a Man, whose Eyes are deprav'd by a suffusion of Gall, takes all things he sees to be Yellow; and perceives the same as clearly, as those who see the true Colour of every thing.

V.
Knowledge
arising
from the
Senses is
Doubtful.

It remains therefore, that all the Certainty we have, is only of those things which we apprehend with our *Understanding*. Neither doth it destroy this Rule, that some tell us they have sometimes been deceived even in those things which they thought to be most true, and which they were confident they had clearly perceived. For this happens to them, because they derive the clearness of their *Cogitation*, not from their *Mind*, but from their *Senses*, or from some preconceived Opinion: For we can never doubt of those things which we clearly and distinctly know. As will be evident to those who by frequent Meditation, and earnest Study, have acquir'd a habit of Judging between a clear and dark Conception.

VI.
The cer-
tainty of
our Percep-
tions de-
pends on
the Under-
standing.

We are also to take Notice, that when we assert that to be true which is evidently and distinctly known by us; and therefore that we are not to give our Assent to things that are not so known by us, this is not to be understood of Matters of Faith; forasmuch as they are not accompanied with any such Evidence, neither have we any clear Notions of them, as we have of the Subjects of Natural Sciences. For there is a vast difference betwixt the Mysteries of Faith and Natural things, because in these Evidence, but in the former Authority commands our Assent. That a Man may be a Believer, he must believe without Evidence; but to be a Philosopher, he must have a clear and distinct Perception.

VII.
The fore-
said Rule
is not to be
extended to
Believers.

If any Man demand, How he may be sure of his knowing a thing clearly and distinctly? I answer; If he follow the Order prescribed by right Reason; if he do not precipitate his Judgment, before he be enlightened with the Truth of Evident Perception. So that the Judgment of our Understanding must always go before, as it does when we never assert or deny any thing, except it be of Things we have clearly and distinctly perceived; that is, when our Judgment is exactly conform to our Perception. For it is not a sufficient Argument for us to embrace any Opinion, because there is Truth in it, except the same do appear to us; so as that our Perception may be the Rule and Line of Truth to us.

VIII.
How a man
may be cer-
tain that
he clearly
knows a
thing.



To the Right
Thomas Mompesson
in Wilt-shire
This Plate is humbly



Worshipfull S.
of Bathampton
Knight
Dedicated by Rich: Blome

A Transition, containing the Substance of what hereafter follows, concerning the clear and distinct Perception of Things.

IX.
The Order
or Series of
things to
be handled
in the first
Part of
Logick.

Forasmuch as it hath been made out, that the clear and distinct Perception of the *Mind*, is the one and only Rule for the attaining of *Truth*; it remains now that I shew, how the *Mind* may arrive to the same: Which that I may the more easily accomplish, the following Points are heedfully to be minded.

First, What *Cogitation* it self, or *Perception* is, and what be the Modes of it.

Secondly, What be the *Objects* of our Perceptions, whether Universal or Singular.

Thirdly, How our *Mind* may arrive to the knowledge or Perception of Things, with respect had to the *Things* that are to be known; such as are the *Common Attributes, Causes, Effects, Subjects, Adjuncts, &c.*

Fourthly, Whence the clearness and distinction of *Idea's* do depend, as likewise the Agreement and Disagreement of Things.

CHAP. III.

Concerning the various Modes of Perception; viz. Pure Intellection, Imagination and Sense.

I.
We must
never give
our judg-
ment of a
thing un-
known.

Forasmuch as *Natural Instinct* teacheth us never to judge of a Thing unknown; and since nothing is known to us but what our *Mind* clearly perceives, we will first treat of the Nature of *Cogitation*, before we examine that of *Simple Notions*, to the end we may be able to discern what things are confusedly, and what distinctly apprehended by us.

II.
What is to
be under-
stood by
Perception.

By *COGITATION* in General, I understand all those things which we experience in our Selves, and whereof we are Conscious: Which Description comprehends all the operations of our *Understanding, Will, Imagination and Senses*; for to *Understand*, to *Will*, and to *Imagine*, is nothing else but to represent to our selves the thing whereof we have an *Idea*. And accordingly from these various ways of Perceiving, is deduc'd that first *Truth*, which we meet with in an orderly way of Philosophizing: For because I Think, that is, because I Perceive, Imagine and Feel, it necessarily follows that I exist: And therefore that Proposition, *I Think, therefore I am*, is of undoubted Truth; since it is impossible that I should Think, and yet be Nothing. And so in like manner when I say, *I walk, I write*. Not as if *Walking* or *Writing*, which are perform'd by the Organs of the outward *Senses*, did infer my Existence, because I may think I perform them in a Dream; but only because the Consciousness which is in my Mind, of my *Walking* and *Writing*, could not be there without I did exist.

III.
Our own
Existence
is before
any other
Truth.

I have said, that this Proposition, *I Think, therefore I am*, is the first Truth we meet with in our orderly Philosophizing; because the Existence of our own *Soul*, which we gather from our *Cogitation*, is more known to us than the Existence of any other Beings. For the *Thinking Mind*, which is understood by this word, *I*, doth know it self before it knows any thing else; and the word, *am*, which imports the first Person, is before the word, *is*, which is only applied to the Third Person. For

who is there who doth not first Think of himself as of a particular Being, before he doth of Man in general? It is natural to our Mind to think of a singular Being, which is propos'd to our Sense or Understanding, before we think of a Being taken in general; and therefore this Proposition may well be esteem'd by us as a first Principle, since from this proof of our own Existence, we confirm the Existence of God, of *Material things*, and in a word, of all *Creatures* whatsoever.

I am not ignorant, that this is commonly taken to be the first Principle, *It is impossible for the same thing to be, and not to be*. But I see not how this Proposition can be of any use to us, in order to the attaining of Knowledge, since it doth not prove the Existence of any thing, and doth seem to suppose that something is, which ought to have been prov'd before. For it presupposeth its Division into *Ens* and *Non Ens*, or *Being* and *Not Being*; whence that Maxim is derived, *Every thing either is, or is not*. But our Principle, *I who think do exist*, presupposeth nothing at all; and when all other things are liable to be question'd and doubted of, yet it is absolutely impossible, that *I who think* should not be something; that is, that I should not exist.

There be Three Species of *Cogitation*; *Pure Intellection, Imagination* and *Sense*: For by these Three Modes or Ways the Mind of Man perceives or thinks.

The Mind is said to *Understand* purely, when by her self alone, and by turning into her self, she perceives a thing only by attending to the *Idea* she hath of it; or when she perceives a thing, whereof there is no Footstep in the Brain. And in this manner the *Soul* apprehends things *Spiritual* and *Universal, Common Notions, the Idea of Perfection*, and finally, all her own *Thoughts*: Or likewise when it understands *Material things, Extension* with its Affections: For it is with the *Understanding* alone, that a Perfect Circle, a Thousand Corner'd Figure, &c. can be conceived.

The Mind is said to *Imagine*, when it applies its Knowing faculty to the Body, as intimately present with it; or when it applies it self not to the Thing it self, which is present to the outward Sense, but to the *Phantasm* impress'd by it in the Brain: As when it perceives a *Figure, a Circle, a Triangle, the Stars, a Machin, &c.* And these Perceptions are called *Imaginations*, because the Mind by representing these Things to her self, doth form Images in the Brain; and forasmuch as it cannot frame any Images of *Spiritual things*, it follows that neither can they be imagined.

Lastly, The Mind of Man, by *Sense*, only perceives sensible Objects and things that are more obvious, as being present, and affecting the outward Organs. Thus it perceives *Steeple, Fields, Animals, &c.* and these Perceptions are called *Sensations*.

'Tis by these Three ways only that the Mind of Man perceives things: For whatsoever is represented to it is either *Spiritual* or *Material*; if *Spiritual*, it can be apprehended by the *Understanding* only; if *Material*, then it is present or absent: If absent, the *Soul* represents it to it self by the *Imagination*; if present, it perceives it by Impressions made on the *Senses*. So that there are only Three ways by which the *Soul* apprehends any thing,

IV.
It is im-
possible for
the same
thing to be,
and not to
be, as not
the first
Principle.

V.
Three Spe-
cies or
kinds of
Perception.
VI.
Pure Intel-
lect.

VII.
Imagina-
tion.

VIII.
Sense.

IX.
The Object
of the Un-
derstand-
ing is more
common or
general,
than the
Object of
Imagina-
tion.

thing, viz. by Pure Intellect, Imagination, or Sense.

Hence it is manifest, that the Object of the Understanding is of a larger extent, than the Object of Imagination: For by our Understanding we do not only conceive the Nature of Spirits and of a Body in general; but also the Proprieties of particular Bodies, which cannot be discovered by the Senses, nor by the Imagination neither, being only perceivable by the Intellect. Thus, tho' the Understanding perceives that the Diagonal Line of a Square, is to that degree incommensurable with the side of it, that tho' a Division into infinite parts should be supposed, yet we could never come to a Particle that might be the common Measure of them both: Nevertheless this Truth can never be reached by the Imagination, but rather seems repugnant to it: Because we can imagin nothing but some particular determinate Body, the Species whereof is impress on our Brain, as hath been said.

X.
No Corporeal Species
are required to Pure
Intellection

And tho' the Mind doth sometimes contemplate Material and Corporeal things; yet it doth never admit any Corporeal Species, which are only received into the Brain, on which the Mind doth not depend in its Operations. For in order to Pure Intellection, we have no need of the Brain, but only for Sensation or Imagination. Whence it follows, that we can Understand many things which we cannot imagin. I perceive by the Light of Nature that GOD exists, tho' I cannot represent him to my self by any Image. So likewise I have a clear perception of a Chiliogen or Thousand Corner'd Body; which yet I cannot imagin, that is, presentially behold its Thousand Sides; because the vast number of them confounds the Imagination. Now that I have a clear Perception of a Thousand Corner'd Body appears, because I can demonstrate many things concerning it, as that all its Angles together are equal to 1996 right Angles; which could not be, if I had only a confus'd Conception of it.

XI.
Truth &
Falshood
as not in
the Under-
standing.

It is to be noted, that no Error can be in the Understanding or Imagination, as long as they continue purely in the Contemplation of things: For if the Idea we have of those things it represents be conform with them, it is true; and if it disagree, then is it no representation of them. Moreover, since Falshood or Error consists in our attributing to a Subject what doth not belong to it, or denying of it what doth, it is plain that since the Understanding or Imagination do neither affirm nor deny, there can be no Falshood in them. Neither doth it contradict this, that the Understanding sometimes apprehends a False thing, as when it conceives a Non Entity, or Repugnant terms; as when the Mind conceives one that is no Physician, to be a Physician; in which Conception there can be no Falshood, because it truly conceives a Physician, tho' it apply that Conception to a wrong Subject.

XII.
But only
in the Will.

Wherefore all danger of Mistake is from our Will, when we give our Assent or Dissent to any thing we have not clearly perceived. Yet is not this to be understood, as if we did wilfully embrace Error; but because we do not restrain our Will sufficiently, but reach it forth to those things we do not perfectly understand. For it is another thing to be willing to be deceived, and to assent to those

things in which Falshood is involved. And tho' few be so careless of themselves, as to desire to fall into Error, yet many are willing to give their Assent to those things in which Error is hid. For all Assent belongs to the Will, and is to be numbred amongst its Perceptions. For we see it is in our Power, tho' we perceive a thing, yet to suspend our Judgment, which restraint is the Determination of the Will; as likewise are Desire, Aversion, Dubitation, &c. For to the Understanding only belong Pure Intellection, Imagination, and Sensation.

Since therefore FALSHOOD consists in the hasty Consent of the Will, it can by no means be imputed to the Intellect, because Error is not to be found in Perceptions, neither is it any way intelligible. Yet forasmuch as the Understanding commonly hath imperfect and confused Conceptions of things, it may be said to be an occasional Cause of our Errors. For as our Bodily Sight frequently leads us into Mistake, by representing Objects confusedly and imperfectly to us; so the Understanding having for the most part only a confused Perception of things, is a cause of the Wills falling into many Errors, by assenting to those things which are obscurely perceived by the Understanding.

XIII.
Sometimes
the Under-
standing
is the cause
of Error.

CHAP. IV.

Of the Five Universals, or Predicables.

WE are to suppose in the first Place, that there are Beings that have some reality in the Nature of things; and whose Attributes belong to them, whether the Understanding think so or not. Such are all Substances, and all Attributes or Modes, which denominate or vary them. Others again derive all the Being they have from the Intellect, on the operation whereof they so depend, as to vanish away upon its Cessation; as are all those which are called Entia Rationis (Entities of Reason) in the Schools.

In the Second place we are to suppose, that nothing else is to be understood by the word Universal, than that which agrees or is attributable to many things; as the word Substance, which agrees to Body and Spirit. Wherefore all Universals are in our Understanding, and to speak properly, are only Modes of Thinking. For seeing all Natural things are Singular and distinct from each other, these Universals can have no Unity, but what our Understanding gives them. By Example, Two Lines if separately consider'd, cannot be said to agree in the Notion of a Line; because in the Conception of the one, is included the Negation of the other; wherefore to the end they may agree, we must first frame an Idea, which may serve us for the conceiving of all Lines that are like one another. Thus we put some Common Name upon all those things which are represented by an Idea, which Name is commonly called an Universal. And thus that famous Number of Universals, which hath rack'd so many Brains, may easily be salv'd.

For Example, When we consider Substance extended in Length, Breadth and Depth, we frame an Idea of it, and call it the Idea of a Body, which afterwards is of use to us for the representing of all Bodies to our Mind. But seeing that many of them are distinguish'd by Species, as into Living Bodies and

I.
There is a
twofold
Genus of
Beings or
Entities.

II.
Universals
are only
Modes of
Thinking.

III.
How Uni-
versals are
formed.

and *Inanimate*, the Universal Name with relation to them is called *GENUS*. And since many of them differ only in Number; as *two Lines* of the same Magnitude, or *two Spherical Bodies*, we conceive an *Universal Idea*, which may represent all Lines that are measur'd by the same length, and all round Bodies contain'd within the same Surface; which *Idea*, with reference to them, as Numerically distinct, is called *SPECIES*, which is the Second Universal.

IV. Whence it follows, that one and the same Universal, with respect to the self-same Inferiour, may be considered either as a *Part*, or a *Whole*: For both the *Genus* in respect of the *Species*, and the *Species* in respect of the *Individuals*, is called a *WHOLE*: Thus *Animal* contains a *Man* and *Beast*. Universals also may be look'd upon as *Parts* of their Inferiours; so a *Man* is conceived as consisting of his *Genus* and *Difference*, that is, of an *Animal* and *Rationality*.

V. Neither hath the Universal, called *Difference*, any other Original; for when we consider that there is some difference between those things which we understand to be under the same *Genus*, or *Species*; we apprehend this variety under some common Notion, which we afterwards attribute to every Difference: As *Streightness* or *Rectitude*, whereby a *Line* is distinguish'd from one that is of another Figure. *Roundedness*, whereby a *Globe* is distinguish'd from an *Angular Body*, &c. The *Predicable Proprium* is made, when we abstract one Notion from those that are peculiar to Things, and to which alone it agrees, and to no other: As *Partiition* or *Divisibility*, and *Mobility* to a *Body*.

VI. *Accident* is framed by us, when after we have considered that many things may happen to, or be taken from Things, without the destruction of their Nature, we conceive the Idea of an *Entity* separable from them, which we call *Accident*: Which Name we make use of for the conceiving of all those things, which fortuitously happen to Things. And this is sufficient for the Explication of the Nature of *Universals*, especially to those who do not love to spend their time in vain Questions, or to confound the Notions of Things with fruitless Disputations.

VII. Now that this Division of an Universal, is *Adaequate*; that is, that there are neither more nor less Members of them than these Five, appears thus: The Idea which we frame in our Mind, and make use of to conceive many Things, either represents many Things distinguish'd by *Species*, and then it is *Genus*; or only Numerically distinct, and then it is *Species*; or it represents the Diversity, whereby many *Singulars* differ amongst themselves, and from other things, and then it is *Difference*; or the Property which belongs to them alone, and then it is *Proprium*; or some Contingency separable from their Essence, and this makes *Accident*, or the first and last *Predicable*.

VIII. These Five *Universals* are otherwise called *Prædicabilia*, *Predicables*, because they are *Modes* of conceiving Universal Notions, which are affirmed of many things Truly, Properly, Naturally and Immediately. They are said to be *Modes* of Conceiving, to intimate to us, that *Predicables* are Second Notions. For *Genus* is nothing in it self, but only with respect to those things with which it

is compared; neither is there any *Species*, but with respect to the *Genus* to which it is subjected: neither can *Difference*, *Property* or *Accident* be conceived, but with relation to the Subjects they belong to.

CHAP. V.

Universals singly examin'd, as to their Nature, Properties, and Use.

THOUGH I have in the foregoing Chapter sufficiently made out, that there are Five *Universals* or *Predicables*, and that they are distinguish'd from each other by their Differences; yet I suppose it may be of use to give a more particular Explication of them, and set down how they are predicated of their Inferiours.

GENUS deserves the first place amongst *Universals*, both in order and dignity; for from it, as from their Head, the other Members depend and are maintain'd, and upon its ceasing perish and vanish. *Genus* therefore is an *Universal*, which is predicated of many things distinct by *Species*, in the Question *what it is*. As *Substance* is a *Genus* in respect of Substance extended, called a *Body*, and Substance Thinking, which is called a *Mind* or *Spirit*; and a *Quadrilateral* or *Square Figure*, is the *Genus* with respect to a *Parallelogram* and a *Trapezium*. To be predicated in the Question *What*, is when enquiry is made into the Nature of any thing, what it is. Thus when I enquire what a *Body*, or what a *Mind* is, the Answer is properly made by their *Genus*, viz. *Substance*; and herein it differs from *Difference*, *Property*, and *Accident*: For tho' *Difference* be predicated by *What*, or *Essentially*, of those things whose Difference it is; yet it is not simply predicated so, but with the addition of *Quale*, which denotes the Form or Quality of a thing; and *Property* and *Accidents* are only predicated in *Quale*.

Wherefore in the foregoing Definition of *Genus*, to be distinguish'd by *Species*, is to differ *Essentially*, so as that some *Essential* part is found in the one and not in the other. Thus *Man* and *Beast* are said to be distinct by *Species*, because a *Mind* or *Rational Soul* is found in *Man*, which is not to be met with in a *Beast*.

Genus is twofold: One, the most General or Highest, which hath no *Genus* above it: As a *Corporeal Being* amongst extended Substances; and an *Intellectual* or *Thinking Being*, amongst those that are endow'd with Knowledge and Understanding.

The other *Genus* is called *Subaltern*, which intervenes betwixt the highest *Genus* and the lowest *Species*; or which with respect to the things above it is a *Species*, and with respect to the Inferiour is call'd *Genus*. Thus *Living Thing*, if it be referr'd to *Body*, under which it is sort'd, is called a *Species*; but if to *Animal*, it is a *Genus*. And consequently, *Body* is a remote *Genus* of *Animal*, but *Living Thing* the nearest *Genus*.

The Second Universal is *SPECIES*, which is predicated of many, only Numerically distinct in the Question, *what a thing is*. By the last part of this Definition of *Species* we find it agrees with *Genus*, in that they both of them answer to the Question, *what a Thing is*: As when I ask, *What is Peter?* I answer aright by saying, that he is a *Man*.

Species

I. It is of use to take a review of these Universals.

II. *Genus* takes the first place amongst Universals.

III. *What it is* to be distinguish'd by *Species*, in the definition of *Genus*.

IV. *Genus* is twofold, one supreme or the highest.

V. The other, *Subaltern*.

VI. *What Species is*, and how it is divided.

VII.
The Division of Species.

Species is twofold: The one called the Lowest or most Special; the other, Middlemost or Intervening: The latter of which, tho' with respect to the Genus under which it stands, it be called *Species*; yet with respect to the Inferiours, of which it is predicated, it is a *Genus*: So Animal which is the *Species* of Living Thing, is the *Genus* in respect of Man or Beast.

VIII.
What the most Special, or Lowest Species is.

The most Special, or the Lowest Species, is that which is immediately predicated of *Individuals*: As Man of Charles and James; a Circle of all particular Circles: Which is therefore call'd the most Special or Lowest Species, because it hath no Species under it, but only *Individuals*. Wherefore also it is commonly defined, that which is predicated of Many, differing only Numerically in the Question which asks, What a thing is?

IX.
How many ways Difference is to be understood.

The Third Universal is *DIFFERENCE*, which may be variously considered: First, forasmuch as it is the Constituent of *Species*; and then it may be defined to be that whereby the *Species* doth exceed, or is more worthy than the *Genus*: As Man exceeds an Animal or Sensitive Creature by *Rationality*. Secondly, As it is something *Predicable*, and so it is commonly defined to be an *Universal*, which is predicated of many different in *Species*, in the Question, Quale quid, or of what kind of Essence a thing is. And this Definition agrees only to the intermediate *Difference*. Thirdly, Inasmuch as it divides the *Genus* into differing *Species*; thus *Rational* and *Irrational* divide *Animal*, and constitute two *Species*, viz. *Man* and *Beast*. So the Equality of the Sides constitutes an *Equilateral Triangle*, and determines the Idea of a *Triangle*, which before was common to a certain *Species*. Fourthly, As it is an Essential part of the whole Compound, and so it makes a part of its Essence, and belongs to its Definition: Wherein it differs from a *Property* and *Accident*, as being an Actual part of the things to which it is attributed.

X.
The Species includes more than the Genus.

For in every *Species* there must necessarily be something more than there is in the *Genus*; for otherwise there would be no distinction at all between the several *Species*, seeing they all agree in the *Genus*; and therefore if there be any diversity betwixt them, the same is to be fetch'd from the *Difference*. For Example; The *Body* and *Mind* are two *Species* of Substance, and therefore it is necessary that in the Idea of *Body* there should be somewhat more found than in the Idea of *Substance*; and the same must be said of the Idea of the *Mind*. Now whereas the first thing we meet with in a *Body*, is *Extension*; and in the *Mind* or *Soul*, *Cogitation*; we may say, that *Extension* is the *Difference* of Bodies, and *Cogitation* the *Difference* of the *Soul*: Or in other words, That a *Body* is a Substance extended, and the *Soul* or *Mind* a Thinking Substance. Wherefore *Difference*, as it is the Third *Predicable*, may be thus defined: That which is predicated of the *Species*, and of the things contained under it by the Question, Quale quid, or of what kind of Essence the thing is.

XI.
The fourfold division of Property. The first Mode.

PROPRIUM is taken in a Fourfold Sense or Acception: First, That which agrees alone to the *Species*, but not to all the *Species*; that is, to all the *Individuals* resorting under it. As, to Cure by Art, is attributable to Man alone, but not to all his *Individuals*.

Secondly, That which agrees to the whole *Species*, but not to it alone. As it agrees to Man to walk on two Feet; for the same may be also said of other *Animals* yet not of all. So *Divisibility* is the Property of *Extension*, because every extended Being can be divided; tho' *Duration* and *Number* be also divisible.

Thirdly, That which is attributable only and to the whole *Species*, yet not always, but only at a certain time: As to grow grey-headed is peculiar to a Man; not in his Childhood or Youth, but in his Old Age: For if it happens otherwise, it is look'd upon as a Prodigy.

Fourthly, That which is attributable only, and to the whole *Species*, and at all times: As it is the property only of a Circle, of every Circle, and at all times, that all the Lines drawn from the Circumference to the Center, are equal. And this last sort of Property is that which constitutes the Fourth Universal; the other three Modes being rather referable to *Accidents*, because they do not agree necessarily, nor always, nor to the whole *Species*, but contingently, sometimes and in part only. And thus *Proprium* in this last Sense may be defined, that which is predicated of many things by themselves, and necessarily, yet not essentially. I have added the word *Necessarily*, because Property doth so agree with a thing, that it cannot so much as by Thought be separated from it; forasmuch as it is a necessary consequent of its Essence, and is convertible with it. Thus it is the essential Property of a *Triangle*, that two of its Sides taken together, are bigger than the third, and that its three Angles be equal to two right ones; because these do necessarily agree to a *Triangle*, inasmuch as it is a Figure bounded by three right Lines.

In the last place, we call all that *Accident*, which is not *Substance*, neither doth necessarily agree to it, but doth only contingently follow the same; or is that which without the destruction of the Subject may be present or absent. As Roundness, Hardness, &c. are common *Accidents* with respect to a *Body*, as Sorrow and Fear are *Accidents* with regard to the *Soul* or *Mind*. An *Accident* is twofold; *Separable*, which may easily be separated from the Subject in which it is conceived to be, as sleep, from Man; or *Inseparable*, which cannot be separated from the thing in which it is by the force of Nature, as whiteness from a Swan, blackness from a Blackamore: Tho' they may be abstracted by Cogitation; for we can conceive a Swan without whiteness, and a Man without blackness. Wherein, as hath been said, it is distinguish'd from a *Propriety*, which cannot so much as by Cogitation be removed from its Subject.

When an *Accident* is said to be present or absent without the destruction of the Subject; this is not to be understood in a *Conjunct* Sense, as if the same *Accident* could at the same time be present and absent from the same Subject: But in a *Divided* Sense, so as that the *Accident* which is now present may be absent, and on the contrary. For it is a Contradiction that two opposite *Predicates*, should at the same time be predicated of the same thing, though they may at divers times.

To the end that the Order of the Highest *Genus*, and those that are Subaltern, as also of the *Species*, may be the better known, it will be of use to subjoin here a Series of *Universals*, by which we may

XII.
The Second.

XIII.
The Third.

XIV.
Proprium in the 4th Mode.

XV.
What an Accident is, and how many ways it is taken.

XVI.
The definition of Accident is true in a divided Sense, not in a Conjunct.

XVII.
The Series of Genus's and Species

be able to descend from the highest *Genus*, to wit, Substance, to *Individuals*; and remount back again from the *Individuals* to the highest *Genus*. For by this Scheme the Mind is much enlightned, and avoids that Confusion, which otherwise is apt to arise in the Defining, Dividing, and Enumerating of things.

A Substance,	Intellectual.
Corporeal,	
A Body,	
Living,	Void of Life.
A Living Thing,	
Sensitive,	Void of Sense.
An Animal, or	
Sensitive Creature,	
Endued with Mind,	Void of Mind.
A Man,	

This, Another, Plato.
The Words which follow from *Substance* to *Man*, are called *Intervening Genus's*, and those on the Right and Left are the *Differences*, which are said to be placed in an Indirect Line. From those words which are disposed in a Direct Line, we make the Series in a twofold manner; either by Analysis or Division descending, beginning from the Highest Genus, which is *Substance*, and distributing it, and all other the *Genus's* that resort under it, into their Species by their Difference, till we come to the *Individuals*. As if one should divide *Substance* into *Corporeal* and *Intellectual*; and then a *Body* into *Living* and *Void of Life*; and then a *Living Body*, into that which is Sensitive and devoid of Sense; and a *Sensitive Creature* or *Animal*, into that which hath a *Mind*, and which is destitute of it; and at last, an *Animal* endued with a *Mind*, viz. a *Man*, into *Plato*, *Socrates*, *Aristotle*, &c.

The other is by way of *Synthesis* ascending, beginning from the *Individuals*, and from them mounting to the *Subaltern Genus's*, and lastly to the Highest Genus, viz. *Substance*. As when considering all particular Men, and finding them all to agree in the Nature of Man, we place *Man* as the Species above the *Individuals*. Then comparing *Man* with *Animals* or *Sensitive Creatures*, and finding in them the common Nature of *Animals*, we place *Animal* as the Genus above *Man*. Afterwards making a Comparison of an *Animal* with *Plants*, and finding them to agree in the common Attribute of Life or Living; we put *Living* above *Animal*: And then if we compare Living things with those that are destitute of Life, we shall find the common Notion in them both; and therefore place *Body* above *Living*. Lastly, If we compare *Bodily things* with *Angels* and the *Mind* of Man, we shall find the common Notion of Substance in them both; and therefore will place *Substance* as the Genus above *Body*, by which means *Substance* will be left the Highest Genus.

A *Singular* or *Individual* is opposed to an *Universal*, because it cannot be common to many Inferiour; as *this Man*, *this Sword*. It is twofold, either Indeterminate, which without difference may signifie this or the other *Individual*; as a *certain Man*, a *certain Woman*: Or Signate and Determinate; as *Julius Caesar*, which is called Determinate by its Signification; or by Demonstration, as when a common Word is determined by a demonstrative Particle; as *this Colledge*, *this Court* or *Yard*: Or by Circumlocution; as the *Son of Sophroniscus* for *Socrates*, or the *Son of the Blessed*

Virgin for Christ: And are therefore called by *Aristotle*, *Individuals*, *Singulars*, and Things differing in *Number*, because they cannot be divided as the fore said *Universals*; and because we in a manner point at them, as if we were counting of them one by one, when we say *this*, *that*, *the other*, &c.

Hence it appears what is the Use of *Universals*, and how far they conduce to the Knowledge of Things: For seeing that a thing considered under an *Universal Notion*, is a thing, as it is apprehended common to many Inferiours, or as it is predicable of many; we shall find that the consideration of *Universals*, is a great help to clear and distinct Perception, the obtaining of which is chiefly aimed at by all that is handled in this LOGICK. For by the help of these *Universals*, or *Prædicables*, we are enabled to discern the Attributes which constitute the Essence of a thing, from those which are Consequent to, and to know which are the *Properties* and *Accidents* of every thing: As for Example, it belongs to the Constitution of *Socrates* his Nature, that he be a *Man*, a *Sensitive Creature*, and *Rational*: Which Three in their Universality are distinguish'd; *Man* being the *Species*, *Sensitive Creature* or *Animal* the *Genus*, and *Rational* the *Difference*. Which tho' in *Socrates* they are all one and the same, yet are distinguish'd according to our Mode of Thinking. But the Faculty of *Laughing*, or *Laughter* it self, is consider'd as a consequent of *Socrates* his Essence, who is already constituted a *Man*, by his being an *Animal* and *Rational*. And the Faculty of *Laughing* is the *Property* of *Man*, but the Act of *Laughing* an *Accident*.

The Consideration of *Universals* is also of great Use to the more clear Perception of Things, whether they be Singular or Common. Of *Singulars*, whilst we enquire under what Species they are placed, what Genus's they have, ascending by degrees to the Highest. Of *Common* or *Universals*, when we examine what Differences they have, and what Species they contain, descending in this manner to the very *Individuals*. Thus by ascending, I know *Socrates* to be a *Man*, a *Man* to be an *Animal*, an *Animal* to be a *Substance*: And again by descending, I learn that *Substance* is either *Intellectual* or *Corporeal*; the *Intellectual* to be either *Infinite*, as *God*; or *Finite*, and that either without a *Body*, viz. an *Angel*, or joyned to a *Body*, as *Man's Soul*; under which Species the *Mind* of *Socrates*, as a *Singular* or *Individual* doth resort.

The Second thing which follows from the Consideration of *Universals* is, that there are two ways of framing General Idea's, the one by *Aggregation*, the other by *Abstraction*. The Mind forms an *Universal Idea* by *Aggregation*, when it joyns many *Singular Idea's* of a like Nature together into one complex *Universal Idea*, which is called *Genus*. Thus making a Congeries or Collection of all Brute Beasts, as of *Lions*, *Horses*, *Bears*, &c. we find them all to agree in the Idea of a Brute Beast, which we therefore call the *Genus* of them.

Again, we may form an *Universal Idea* by *Abstraction*, when we attribute the Attributes which constitute the Essence of a thing into several ranks or degrees, as if they were so many Parts. For tho' the Idea's of *Singular* things do agree in some one thing, yet they differ in more; wherefore when the *Mind* doth abstractedly and severally consider

XX.
The first Use of *Universals*.

XXI.
The second Use of *Universals*.

XXII.
Our Mind frames a general Idea two several ways, the one by joyning or aggregating.

XXIII.
The other by Abstraction.

XVII.
Which Series may be made after an Analytical way.

XVIII.
Or by a Synthetical.

XIX.
What an Individual is, and its division.

things, in which many like Idea's are found, neglecting those wherein they differ; this abstract Consideration is called an *Universal Idea* or *Genus*. As for Example, If I take from *John*, *Peter*, *James*, all the Particularities that determine them, as that the one is a *Physician*, the other *old*, the third *young*, &c. and that I only consider them as being all *endued with Sense and Reason*: This affords me the General Idea of a *Man*, forasmuch as thereby not any particular Man is represented to me; but Man in Common, or the Nature of Man as such.

CHAP. VI.

Of Substance, and its Affections or Modes.

I.
The difference of our Perceptions.

THe difference of *Perceptions* or *Idea's* is taken either from the Things themselves which we understand, or from our different ways of Perceiving them, or lastly proceeds from the *Words* or *Signs* whereby we express our Notions. Now whatsoever is understood by us, is either conceived as a *Thing*, or *Substance*, existing by it self; or as the Attribute of a Thing, or Mode of *Substance*; or as something made up of a *Thing* and *Mode*; or a *Modified thing*; or lastly, *Propositions of Eternal Truth* residing in our Mind.

II.
What Substance is.

Substance is a thing, which does not need any other Substance for its existence; that is, which hath an *Essence* really distinct and separable from others. By this means is a *Substance* distinguish'd from an *Accident*, which is not really distinct from a *Substance*, nor can exist separate from it: Nay, an *Accident* cannot be clearly and distinctly conceived without a *Substance*, because its very *Essence* is to be in another; and nothing can be clearly and distinctly conceived without its *Essence*.

III.
Substance is known by its Attributes.

Tho' it be sufficient for the Explication of the Notion of *Substance*, to say, that it is a thing which exists independently of another; yet we cannot distinctly understand it, but by means of some Attributes that belong to it; and the more of these are found in any *Substance*, the clearer it is said to be known. For the *Attributes* or *Properties* of Things are, as it were, certain Forms that actuate them, and distinguish them from others: For we more easily know a Rational Soul, by conceiving it as a *Thinking Substance*, than as a thing *Existing*; because if it thinks, it must of necessity exist. So in like manner we have a clearer knowledge of a Body, by considering it as a Thing extended, than only as a thing existing, as is evident to him that considers it.

IV.
A Substance is either Created or Uncreated.

SUBSTANCE is twofold, *Created* or *Uncreated*. *Uncreated* is a Substance independent of all other things whatsoever, as *GOD*: A *Created Substance* is that, which tho' it do not stand in need of another Substance for its Existence, yet wants the Divine Concourse, without which it cannot exist; and therefore is not an absolute, but only a dependent *Being*.

V.
Created Substance is divided into Intellectual and Corporeal.

Of *Created Beings*, some are *Intellectual*, others *Corporeal*. An *Intellectual Being* is a Thinking Substance, as the *Mind* of Man: A *Corporeal*, is a Substance extended in Length, Breadth and Depth; or is the immediate Subject of Local Extension, and of all Modes that presuppose Extension, as *Magnitude*, *Motion*, *Figure*, *Position*, and all other such like, which cannot be conceived without Local Ex-

ension, as the foundation of them. And to the Mind or Soul belong all Acts or Modes of *Cogitation*, as to *Understand*, *Imagin*, *Feel*, and whatever else agrees in the universal Notion of *Cogitation*.

Whence follows that there are only two *Genus's* or General Heads of Things, viz. of *Material* and *Intellectual*, or *Cogitative*: All others being reducible to these as *Modes* or *Affections*; now what these are, and how related to their Subjects, we shall next proceed to explain.

There be many Attributes we may conceive in every thing; some of which constitute the Nature and *Essence* of a thing, and distinguish it from all others; as *Extension*, which constitutes a Bodily Substance; and distinguishes it from a Cogitative Being: Others again presuppose the Nature constituted, and do only diversly affect or vary the same, as *Volition* doth the Mind, and *Figure* the Body; and these are called the *Modes* of *Substances*. Because tho' they affect or vary the Substance, yet it may be conceived without them, tho' they themselves cannot be understood but as inherent in some Subject; for herein properly the Nature of a *Modus* doth consist, that it cannot be conceived without including the Conception of the thing whose Mode it is. Thus I clearly perceive that a *Body* is an extended Substance, without Motion or Figure: But it is impossible for me to conceive Motion or Figure, except it be in an extended Being. So likewise I clearly perceive the *Mind* to be a Thinking Substance, without *Imagination* or *Sense*, because tho' these were absent it would be Cogitative notwithstanding: But *Sense* and *Imagination* cannot be conceived, but in a Cogitative Being.

Wherefore a Modern Philosopher calls a *Mode*, the *Appendix of a Being*; because it cannot exist without the thing whose *Appendix* it is. Which we are to observe in opposition of those, who suppose that the *Modes* of things differ not at all from Real Accidents; forasmuch as these, according to them, may be conceived separate from their Subjects, and can exist so by the Divine Power: Whereas *Modes* can neither be separated from their Subjects, nor conceived without them; for otherwise they would be *Substances*, whose Nature it is to be Things subsisting.

Substance therefore is a thing that subsists by it self, and is the Subject of all the Attributes that are conceived to be in it.

A *Mode* is that Attribute or Quality, which is conceived to be in the *Substance* it self, which determines it to be such like. And this *Mode* is called by us an *Imperfect Being*, because it belongs to the Nature of it, that it cannot be by it self, and without some Substance in which it is; and whose *Being*, as the Schools express it, is nothing else but *Inbeing*; so that it is a contradiction for a *Mode* to be, and not to be or exist in a Substance. Wherefore neither can a *Modus* pass from the *Substance*, which is its Subject, and does support and uphold it, into another; for this would argue it not to have been dependent on the Substance wherein it was before, which implies a Contradiction.

Of *Modes*, some are Internal, others External: *Internal* are such as are conceived to be in the very Substances, as *Figure*, *Motion*, *Rest*, &c. *External* are such as depend on other Things, and are not in

VI.
There be only two Genus's of Things.

VII.
What an Attribute or Modus is.

VIII.
How Modes are distinguish'd from Aristotelical Accidents.

IX.
What a Substance is.

X.
What a Mode is.

XI.
The division of Modes into Internal and External.

in the Substances themselves; as to be *Beloved, Desired, &c.* which are Modes depending on the Action of another; and the Expressions we make use of to signify the said Modes, are called *Extrinsic Denominations*; because they only express the Modes under which things are conceived.

A *Thing modified* is the Substance it self, which is determined by a *Modus*.

As when I consider a *Body*, the Idea I have of it represents to me a *Body* or Substance, because I apprehend it as a Self-subsisting thing, which needs no outward thing to its existence: But when I consider that *Body Round* or *Square*, the Idea which I have of its Roundness or Squareness represents nothing else to me, but a certain Mode of Existence, which I find cannot naturally exist without a *Body*, to which the Roundness or Squareness belongs: And lastly, when I joyn the Mode with the Thing, that Idea represents to me the Thing modified.

From what hath been said, it follows, First, That the *Modes* of Things are no hindrance to their Simplicity: For *Extension*, by Example, with the various Modes of Extension, as *Figure, Motion, &c.* is not a Compound, but a Simple thing. For that is said to be a *Compound* which contains two, or more Attributes, whereof the one may be distinctly perceived without the other; and since the *Modes* cannot be considered without the *Substance* in which they are, it cannot be said that they make a Compound of it. A *Simple Being* is that in which one only Attribute is found; whence it follows, that that Subject in which *Extension* alone, with its various Modes is understood, is a Simple Being; and that wherein we only apprehend the Cogitative Faculty, with the various Modes of *Willing, Understanding, Imagining*, is likewise a Simple Being: But that which comprehends both *Extension* and *Cogitation* is a Compound, viz. *Man*, who consists of *Soul* and *Body*.

Secondly, Hence it follows that a *Substance* may sometimes be applicable to another in manner of a *Mode*. So *Cloaths*, when a Man is said to be *Clothed*, must only be called a *Modus*, notwithstanding that they are Substances; because Man is then considered as a Subject, to which *Cloaths* are added in the manner of a *Mode*.

Thirdly, From what hath been said we may gather, that we may conceive some difference between an *Attribute*, a *Mode*, and a *Quality*: As that an *Attribute* is that which is generally conceived to be in a Substance; so he who thinks of the Duration of the *Sun* doth contemplate an *Attribute*, under which the *Sun* is understood, forasmuch as it continues in its being. And thus all Attributes are then distinctly understood by us, when we take care to affix no Conception of a Substance to them. We call that a *Mode*, which any way affects or varies a thing: So *Wax* is diversified by Figures. And a *Quality* is that whence a Substance is denominated *Talis*, or such like; as *Wax*, that is, *soft, cold, white, &c.* so *softness* is the Quality of *Wax*.

The Names whereby we express Substances, are called *Nouns Substantive*, as *Mind, Body, &c.* The Names which express Things modified, and which primarily and directly signify Substances, and Modes indirectly, are also *Nouns Substantives*: As the *Earth, the Sun, &c.* But Words that primarily and directly, but confusedly signify Substances, and

which indirectly, but distinctly express Modes, are called *Nouns Adjective*; such are *round, white, just, &c.*

The other things which fall under our Knowledge, are Propositions of *Eternal Truth*; which are not understood as Existing things, or the Modes of things; but as *Eternal Truths* abiding in our Understanding: As, *That which is, whilst it is, cannot be nothing: I am, because I think: What is once done, cannot be undone*; which are therefore called *Common Notions*, because they are so simple and clear, that they cannot but be perceived by all Men. Neither must it be look'd upon as an Absurdity, that we call any thing *Eternal* and *Immutable*, besides GOD; because we do not speak here of Existing things, but only of Notions and Axioms which are in our Mind.

Neither doth it hinder the Truth of these Propositions, that all of them do not appear equally evident to all Men; for the Reason of this is, because they are not all conceived after the same manner, and consequently not with the same Evidence. Not that I think the *Minds* of Men to be divers, and that the *Knowing Faculty* of one Man is larger than another's; but because probably these *Common Notions* may thwart the prejudicate Opinions of some Men, who therefore cannot so easily apprehend them; tho' others that are free from such Prejudices, do perceive them with the greatest Evidence.

CHAP. VII.

Of the Common Attributes of Substance.

Forasmuch as Things are understood by their Attributes, and are the more distinctly conceived by us, by how much the more Attributes we apprehend in them; I thought it needful to reckon up all the Attributes of *Substance*, that so nothing that belongs to the Nature of it, may be concealed from us.

The Attributes of *Substances* are either Primary or Antecedent, or Originate and following from the Antecedent. The *Primary* are those which are considered by us as certain Principles (not Effective, but Formal) as well of the Substance, as chiefly of all the rest of the Attributes; seeing that when they are supposed, the others immediately follow, and are therefore called the *Principles of Being* or *Substance*; and they are two, viz. *Essence* and *Existence*.

ESSENCE is the first Radical and inward Principle, Foundation, and Root of *Substance*, and all its Properties and Operations: For it is the Entity or Form whereby it is something, and that which it is. Thus a *Spiritual* thing, suppose an *Angel*, by means of its *Essence* is not only a thing, but also such a Being that is Intelligent, and not a *Material Substance*. And so likewise a *Body* hath not only from its *Essence* that it is something, but also that it is *Material*, and void of Understanding. And therefore the *Essence* is by the Schools called, the *Metaphysical Form*, because it is the Chief thing whereby a Thing is distinguish'd from all others. When I say, the *Chief Thing*, it is not to be understood as if there were something in Substance, besides *Essence*, but only with respect to our Perception, which commonly proceeds by Parts, tho' the Thing it self be Simple, without any Composition.

Having

XII.
What a
thing Mo-
dified is.

XIII.
These Three
things ex-
plain'd by
an Exam-
ple.

XIV.
Modes
make no
Compound
of the
thing whose
Modes they
are.

XV.
Substance
is some-
times con-
sider'd as
a Mode.

XVI.
The distin-
ction be-
twixt an
Attribute,
a Mode,
and a
Quality.

XVII.
With what
Names Sub-
stances and
Modes are
express'd.

XVIII.
What Pro-
positions of
Eternal
Truth are.

XIX.
The same
are per-
ceived by
all, except
their Pre-
judices
hinder
them.

I.
The Attri-
butes by
which
Substance
is known.

II.
There are
two Genus's
of Attri-
butes.

III.
Essence.

IV.
Existence.

Having inform'd our selves *what the Thing is* that is in question, the next enquiry is, *Whether it be*; that is, whether such a thing be to be found in the Nature of Things; to which the foresaid Essence doth belong; and to this Question *Existence* belongs, by which a *Being* is said to subsist, or by which the Essence is constituted in the Nature of Things: And therefore is called *Actus Entitativus*, an *Entitative Act*; as if Existence were only understood by the operation or acting of Things. A Being in *Potentia*, or a *Possible Being*, is oppos'd to a Being in *Act*. So a *Lilly* in Summer is said to be an *Existent Being*; but in Winter, a *Possible Being*, *Ens in Potentia*; because tho' it do not then exist, yet it is not repugnant to it, to be or exist in Time. Whence it appears that *Essence* and *Existence* cannot be separated from each other, since (to speak properly) they are nothing else but two different Modes of Thinking: For we do otherwise conceive the Essence of a thing, when we abstract Existence or Non-existence from it, than when we conceive it Existing. So when we apprehend *Possible* and *Actual Being* in one and the same thing, by different Conceptions, we do indeed conceive the thing as in a twofold State, but do not therefore divide it into more things. Thus the *Sun* that now appears in our Heaven, is the same that has continued from the beginning. Therefore the Power by which things that are not yet, are said to be Possible, is called *Objective*; forasmuch as such Things are the Objects of some Cause, by which they may be produced in due place and time.

V.
Attributes
Originate,
or proceed-
ing from
others.

From these two first or primary Attributes, other Attributes follow, which are likewise common to all Substance, and are called *Originate*, or *Consequent*; and are either *Absolute*, which belong to the Substance considered by it self; or *Respective*, which agree to the Thing with reference to others. The Absolute Attributes are *Duration*, *Unity*, *Truth*, *Goodness*, &c.

VI.
Duration.

Duration is nothing else but an Attribute, under which the Existence of Created Things is understood, with reference to their perseverance in their Actual existence. So that *Duration* agrees to all *Existent Beings*, as long as they exist. With respect to *Duration*, some things are called *Corruptible*, and others *Incorruptible*. A *Corruptible Being*, is that which can perish and cease to be, or lose the Existence it hath: As the *Individuals* of every Species, which may be corrupted and changed into another Species. An *Incorruptible Being* is that, whose Existence cannot be destroyed, and is either Simply such, as *GOD*, who is *subject to no Change or Corruptibility*; or in certain respects only, which is preserved by the Power of *GOD*, so as to suffer no diminution or increase. So *Matter* which continues one and the same in the World, is said to be *Incorruptible*; tho' second or singular *Matters*, as to their Forms, be subject to Generation and Corruption.

VII.
Unity.

Another Attribute of Substance is *Unity*, by which every thing is said to be Undivided in it self. Thus those things are said to be *One*, which are of the same Subaltern Genus or Species, because they are considered by us under one and the same Notion, and for that we make use only of one Conception, to represent all those Things to our Minds which agree together: And this *Unity* is called

Universal. But *Singular Unity* appertains to those Things, which without the Operation of our Mind are undivided, or to whose Nature it is repugnant to be divided into more *Entities*; whereby is verified that Common Saying of the *Philosophers*, That *whatsoever is, is Singular*; because that which is not *One*, cannot be esteemed to be. Some Things again are *One* by themselves, and others by Accident: Things *One by themselves* are such as have an Undivided Nature, whether they be Simple or Compound. For the multitude of Parts is no hindrance of *Unity*, so the Parts, which constitute a Third thing, be but closely joyned together. For *Man* is said to be *One* by himself, notwithstanding that he consists of Parts of a different Nature, and separable from each other. Whereas those things are called *One by Accident*, which consist of disjoyned Parts, and between which there is only a very slight Union. So an *Army* is called *One Body* by Accident, because it consists of a great number of Men joyn'd by an Imperfect Union.

In Substance we also consider *Truth*, which is commonly called *Metaphysical*, or *Transcendental*; and is nothing else but the correspondence of the Name with the Thing signified by it. For in this Sense the Nature and Essence of every thing may be said to be *True*. So that to enquire into the Nature of any Thing, is the same as to search what a Thing is, and of what kind it is: And to find out *Truth* is nothing else, but to comprehend whether a Thing be, and of what Nature a Thing is. Wherefore, since it is not in the Power of Creatures, to change the Natures and Essences of Things, no more than they can *Eternal Truths*, it follows, that there is nothing oppos'd to *Transcendental Truth*. For tho' *Justice* be oppos'd to *Injustice*, *Truth* to *Falshood*, and *true Gold* to *false Gold*; yet the Things which are oppos'd to *true Vertues* have no Nature, neither have we any positive Idea of them: For that which is opposite to *true Gold* hath no Essence at all; and in like manner, that which is contrary to *True Faith*, or *True Fortitude*.

To *Metaphysical Truth* are referred not only those Things which have, or may have an Existence without the Intellect, as all *Natural Beings*; but also whatsoever is *Positive*, and consequently hath an Essence or Nature, tho' it have no Existence without the Intellect. For not only those Things which are the Object of our Senses, as *Heaven*, *Earth*, the *Sea*, *Sound*, *Colour*, &c. do enjoy a True and proper Essence; but *Fortitude*, *Justice*, a *right Line*, a *Triangle*, *Cause*, *Effect*, and in a word, whatsoever we apprehend as *Positive*, or in the manner of an *Entity*. For we say, *True Justice*, a *True Triangle*, &c. because their Nature is *True*, and because we can demonstrate many things of them; as of *Justice*, that it gives to every thing its own: Of a *Triangle*, that its three Angles are equal to two Right ones.

Goodness follows *Truth*, and is likewise reckoned amongst the General Affections of Substance: For if a Thing have that Essence which it ought to have; that is, if it be *True*, it must of necessity be *Good* also. And therefore we frequently confound the Denominations of *True* and *Good*; as when we call a *True Syllogism*, *Good*, because the thing which agrees with our Understanding, cannot disagree with our Will, in case the Will be right, and

VIII.
Truth.IX.
What
things are
said to be
true Meta-
physically.X.
Goodness.

and that it be carried towards it after clear Perception. Thus GOD, after he had Created the *World*, and all things contain'd in it, he declar'd them all to be *very good*, because they agreed with the Idea's he had of them, and therefore were such as he would have them to be. Wherefore *Aristotle* defines *Good* to be that *which all do desire*; forasmuch as nothing is desired, but what agrees with the Will. As there are many degrees of *Truth*, so also of *Goodness*, whilst we account some more excellent than others, which we more especially do, when we measure the *Goodness* of any thing from its Actions, or the strength and force of its Acting. Thus we say, that the *Mind* excels the *Body*, and the *Fire* the rest of the Elements.

XI.
Relation.

Thus much for the Absolute Attributes of *Substance*; we proceed now to the *Relative*, which agree to a Substance as related to another, and not as considered in it self. Now *Relation* is nothing else, but a Mode of our Understanding, comparing one thing with others, because of some Properties or Acts that are found in them: So a *Father* is Related to his *Son*, because he hath begot him; and the *Son* to his *Father*, as being begotten of him. If we consider a *Father* and *Son* Materially, without their Relation, we shall call them *Subject*; but if we consider them with respect to one another, we shall call the one the *Relate*, and the other the *Correlate*; because as the *Father* is related to the *Son* by *Paternity* or *Fatherhood*; so is the *Son* to the *Father* by *Filiation* or *Sonship*. Upon which account it is that *Relatives* are said to be or exist *Naturally both together*; because you cannot suppose the one, without supposing the other: For supposing a *Husband*, you must suppose a *Wife* too; and supposing a *Master*, he must have a *Servant*.

XII.
Relation is manifold.

Relation is manifold; viz. a Relation of *Origination*, of *Negation*, of *Affirmation*, of *Comparison*, of *Composition*, of *Accession*, and of *Substitution*.

Relation of Origination is, between a Principle and that which proceeds from it; as between the *Day-break* and a *Day*, a *Point* and a *Line*, a *Substance* and its *Properties*.

Relation of Negation, is between distinct Things, or between Things going before, and those that follow after. The former of these is called a Relation of *Distinction*, the latter a Relation of *Order*.

Relation of Affirmation is, whereby one thing is affirmed of another.

Relation of Composition, is between the Whole and the Parts, the Simple and the Compound, the Perfect and Imperfect.

Relation of Accession, is between the Subject and the Adjunct.

Lastly, *Relation of Substitution*, is that which intervenes betwixt the Sign, and that which is signified by it; the Measure and the thing Measured; the Image and the Original.

XIII.
Opposition.

As one *Substance* is related to another, so likewise it is opposed to another: As when we so conceive of Two things, as that they cannot consist together. So *white* and *black Things* are said to be opposed, and these are called *Contraries*, because the Essence of one is different from the Essence of the other; yet not wholly and altogether, but because

there is something in the Nature of one of them, which is not in the other. Those things are called *Disparate*, or *Disagreeing*, when one thing is opposed to many after one and the same manner: As *white* is opposed to *green*, *yellow*, *blew*; because *white* is not only opposite to *green*, but also to *yellow* and *blew*, and all Middle Colours. But when one *Opposite* altogether denies the other; as a *God*, *No God*; they are commonly called *Contradictories*. And this is the greatest of all Oppositions, forasmuch as it denies every where, and always. But if it deny the same only in a certain Subject, as *Sight* in a Sensitive Creature, then they are called *Privative Opposites*: Because by Privation is understood the absence of some Entity in a Subject capable of receiving it, as *Blindness* in the Eye, which is capable of *Sight*.

XIV.
Order.

Order is another Attribute of *Substance*, consisting in first and last, or former and latter. It is various, according to the diversity of *Place*, *Time*, *Dignity*, *Knowledge*, and *Perfection*, which we conceive to be in things. *Order of Knowledge*, is taken from the Things themselves; and by this *Causes* are before *Effects*; *Simple Terms* are more known than *Complex*. *Order of Dignity*, is fetch'd from the Essence of things; thus the *Mind* is more worthy than the *Body*: Or from *Accidents*; thus a *King* is more worthy than his *Subjects*, a *Master* than his *Servants*. A Thing is said to be before another in *Nature*, whose Essence doth precede the other; or from whose Existence the latter is not infer'd, but on the contrary: So an *Animal*, or a *Sensitive Creature*, is said to be by Nature before *Man*; because tho' an *Animal* exist, it doth not therefore follow that a *Man* exists; yet when a *Man* exists, it follows that an *Animal* exists also.

CHAP. VIII.

How the Name of Substance agrees to GOD and the Creatures.

FOR the better clearing of this Difficulty, we are to suppose with *Logicians*, that a Name may after divers manners be communicated to a Thing. First, *Univocally*, when it agrees to many Things for the same Reason; as when the name *Triangle* is given to all Figures contained within three Lines. *Equivocally*, when we call many things that are Essentially distinct by the same common Name, for divers Reasons: As when in Latin we use the Name *Gallus*, to signify a *Cock* and a *Frenchman*; or when we use the word *Parabola*, to signify an *Allegory*, or *Similitude*, and a *Geometrical Figure*. *Analogically*, as when we give the same Name to many Things; but to one Principally, and to the other Secondarily: As when we say that an *Animal*, a *Pulse*, and *Physick* are *Healthful*; for *Health* principally and chiefly agrees only to an *Animal*, to the *Pulse* as it is a sign of it, and to *Medicine*, because it procures it. Having briefly observed these things,

I say, First, that the Name of *Substance* doth not agree to *God* and the Creatures *Univocally*. Which I prove thus: Different *Participation* destroys *Univocation*; but *God* and the *Creatures* participate the Name of *Substance* after a different manner therefore. The Minor is proved, because *God* is a Substance Independent of any other; but all other *Creatures* are Substances dependent of Him:

I.
How many ways Names agree to a Thing.

II.
The Idea of Substance doth not agree Univocally to GOD and the Creatures.

F

Him:

Him: GOD alone is He, who needs no other to his Existence; but all *Creatures* stand in need of the Divine Concourse for their Existence, neither can they without it be conceived to exist in the Nature of Things.

III.
The same
expressed in
other
words.

Or otherwise thus: The Idea of *Substance*, is the conception of a Being subsisting of, or by it self; but there is no *Creature* so exists by it self, as to be sufficient for its own Existence, or so Powerful, as to be able to keep and preserve it self: Wherefore the Name of *Substance* cannot *Univocally* agree to God and the *Creature*.

IV.
A Being
from him-
self and
from ano-
ther, are
absolute
Differences.

And if with more attention we consider the Matter, we shall find that God and the *Creature* do not agree in the Idea of any Genus whatsoever; and that the word *Being*, *Ens*, which is commonly by *Logicians* attributed to God and the *Creature*, is perfectly *Equivocal*; and that the *Equivocation* is not more plain in the word *Dog*, when attributed to a *Constellation* in Heaven, and to a *Beast* on Earth; or in the Latin word *Sanus*, which signifies *Law* or *Right*, and *Broth*, than in the word *Ens*, or *Being*, when given to a Being which is of it self, and to one that is from another and altogether dependent. For to exist of ones self, or to be made by another are meer *Differences*, which do not admit any common Genus; and as God is distinguished by the former, so are all *Creatures* by the latter: God being a purely Self-existent and Independent Being, and the *Creatures* purely dependent Beings, and existing from another.

V.
God is
above
Substance.

Wherefore S. Denys calls GOD *Super-substantia*, and *Super-ens*, (*Above-substance*, and *Above-entity*) because he is raised above all Substances, and separate and distinct from all other Things whatsoever. Accordingly he that would make a true Scheme of the *Predicaments*, must set down *Ens à se*, or a Self-existent Being by it self, and distinct from the Series of other things; and afterwards *Ens ab alio*, or a Being that is from another, as the Original of *Differences*, placing at the Right hand of it *Intellectual*, and on the Left *Corporeal*, and then put the next Division of Things. Because the Name of *Entity*, or *Being*, only agrees with the Being, which is of it self, and can only *Equivocally* be assigned to *Creatures*, that have their Being from another.

VI.
An Objec-
tion an-
swer'd.

If any one say, that the word *Substance* agrees in common both to God and the *Creatures*, and that all the Inequality that is found in them doth arise only from the *Differences* of it? I answer, That this is not true, forasmuch as Dependency is involved in the Essential Conception of a *Creature*. Now it is required to the Nature of *Univocal Words*, that they be equally communicable to all, and not to one Primarily and to the other Secondly, or with dependence on the First.

VII.
The Idea
or Notion
of Sub-
stance is
Univocally
competent
to *Crea-
tures*.

I say in the Second place, that the word *Substance* doth *Univocally* agree to all *Creatures*. For all *Creatures* are conceived under this Common Notion, that all of them stand in need of the Divine Concourse for their Existence. Now that Name which is attributed to many for the same Reason, and equally participated by them, is *Univocal*; therefore the Name of *Substance* is distinctly understood to be Common to all *Creatures*, according to the property of *Univocals*.

VIII.

Having thus explained these Things, I think I

have with one and the same labour explained all *Metaphysicks*, concerning *Entity* and its Affections; yet that no Body may complain, that the same has been left out in this *Institution*, seeing the consideration of it doth indeed belong to *Logic*, I shall subjoyn here such a Genealogy of Things and Modes, by means of which the Student of Philosophy may, as it were at one View, contemplate the whole University of Things.

Why the
Genealogy
of Things
and Modes
is here
annexed.

The Fifth Rule of Truth.

It avails much to the clear and distinct Perception of Truth, to retain in ones Mind an accurate Genealogy of Things and Modes, that with one cast of an Eye we may be able to take a view of the whole Universe of Things, beginning from the most General, and ending in the most Special.

The Reason is, because this will be a great Help towards the thorough Knowledge of Things, as pointing us to what *Tribe* they do belong, what Affinity they have with some, and what Difference from other Things; neither will it be of less Use to us in the defining, describing, and distributing of Things. And to the end you may have a short Compendium at hand, of all those Things in general, which fall under the Perception of our Mind, and consequently also of those *Idea's*, which the Mind forms to it self, whilst it beholds them: Behold I here furnish you with such a Genealogy, as contains all and every one of the Genera of Things and Modes, each in its proper order and degree.

IX.
The Use of
the fore-
going Rule.

The Genealogy of Things and Modes.

Whatsoever falls under the clear and distinct Perception of our Mind, is somewhat.

And that Somewhat, } A Thing, A
or,
is either } The Mode of a Thing, B

I. A Thing, (or an Entity or Substance, for they are Synonymous) is something which hath an Essence and Existence distinct from all other Things. Essence is the Natural and Invariable Constitution of the Thing, by which it is that which it is. Existence is a Consequent upon the Essence of a Thing, by which it now actually is, or is the Essence it self now existing in the University of Things. The Consideration whereof belongs to *Ontologia*, by some called *First Philosophy*, and by others *Metaphysicks*, which treats of Things Universally, and therefore also is called *Catholic*, or *Universal*.

A Thing or Substance in General, is twofold

Thinking, or } 1. Infinite, as GOD, whence is Natural Theology.
a Mind is } 2. Finite, as } an Angel, whence is
either } the Mind } Angelography.
of } a Man; whence Psychology.

This part of the Genealogy of a Thinking Substance is handled in *Noëtica*, that is, *Pneumatica*, as others term it; the Parts whereof I have just now mentioned.

A Thing Extended, or a Body, is twofold.

I. An Element; that is, a Principle whence other mix'd Bodies have their Original, and into which they are resolved again at last. Which again is Threefold.

I. Subtil

1. *Subtil Matter*, which constitutes the *Stars*.
2. The *Heavenly Globular Matter*, whence the *Light* and *Heavens* are.
3. The *Grosser Particles of Matter*, whence are the *Planets* and *Comets*.

II. *Elementatum*, or *Principiatum*; that is, all those things that have their Original from the *Elements*.

And these are again *Twofold*:

I. *Without Life*, or *Concrete*; which branch themselves into,

1. *Simple Concretes*; as the *Heaven*, which consists of the *Globuli* of the Second Element; and the *Stars*, of the Matter of the First Element.

2. *More Compound Concretes*.

1. Those on high, as *Planets*, *Comets*, &c.
2. Those beneath,
 1. *Meteors*, as *Vapours*, *Wind*, as *Fire*, *Air*, *Water*, *Earth*, and things consisting of these: As,
 1. *Rain*, *Snow*, *Hail*, *Thunder*, &c.
 2. *Fossils*; that is, *Common*, *Minerals*, *Metals*, and *Stones* *Precious*.

II. *Living*, or *Animated*.

1. *Without Sense*, or *Vegetable*,

1. *Herbs*, As all kind of *Plants*, whether *Shrubs*, or *Trees*.

2. *Endowed with Sense*;

1. *Rational*, as *Man*.
2. *Irrational*, as a *Beast*.

This Part of the Genealogy, concerning *Extended Substance*, or *Body*, is unfolded in *Physiology*, or *Natural Philosophy*, which is also called *Somatica*.

II. The *Mode*, (that is, the *Attribute*, *Affection*, *Accident*) of a Thing, is somewhat of an *Entity* or *Being*, that is and exists by the assistance of another thing.

These are *Twofold*,

- General, *a*
- or
- Special, *b*

I. *General*; Such are the *Modes* or *Attributes* of all Things in *General*, commonly called *Transcendentals*: As,

1. *Unity*; by which every thing is always one and the same, and Undivided. *Multitude* is a Collection of *Unities*.
2. *Truth*; by which a thing is conformable to its Idea. *Falsity* contrariwise.
3. *Goodness*; whereby it is fit for Use.
4. *Perfection*; whereby it is whole and entire, and hath whatsoever it ought to have.
5. *Locality*; whereby it is every where, as *God*; or somewhere, as all other Things besides *God*.
6. *Duration*; whereby a Thing continues in its Existence either always, or for a certain time:
 - Eternity.

As

- Present,
- Time Past,
- Future.

These Things are explained in the *First Philosophy*, or *Metaphysics*, which treats of Things, and of their *Modes* and *Affections* Universally.

II. *Special*; Such are the *Modes* or *Attributes* of Things in *Specie*.

(I) For the Division of Things: As,

I. The *Modes*, that is, the *Attributes* of a Thing

Cogitating:

- Intellection, and Volition.
- As, Power to act of it self, 'Αυτοκίνησις.

2. The *Modes* or *Attributes* of a Thing extended, or *Corporeal*:

1. *Quantity*, or *Magnitude*; which *Mathematicks*, or *Posotica* treats of.
2. *Figure*, or the different Termination of *Magnitude*, handled in that Part of *Mathematicks*, which is called *Geometry*.
3. *Situation*, or the certain Position of a Thing in Place and Space.
4. The *Quiet* or *Rest* of the Parts of any Thing.
5. *Local Motion*, or the Variation of Situation, whence proceed *Active* and *Passive* Qualities; as *Rarity* and *Density*, *Fluidity* and *Hardness*, *Heat* and *Cold*, *Moisture* and *Dryness*, and the rest; which are treated of in *Natural Philosophy*.

(2.) From the *Thinking*, result the following Conjunction and Modes and Affections of a thing

- Extended.
- ons.

1. The Appetite of *Hunger* and *Thirst*.

Internal; *Phantasy* or *Imagination* and *Memory*.

2. The Senses

- External; Seeing, Hearing, Smelling, Tasting, and Feeling.

And their Affections, as *Waking* and *Sleep*.

3. The Affections or Passions; as *Love*, *Joy*, *Hatred*, *Sorrow*, *Hope*, *Fear*, and the several kinds of them, which are also handled in *Physiology*.

Hence we may gather in the first place, that *Philosophy* considered in all its Parts, is nothing else but a *Scientificall Explication* of this or a like Genealogy. For a *Philosopher* pretends nothing else, and is content with this alone to understand the *Natures* of Things, to know their *Forms*, *Differences*, *Affections*, and that from the nearest Causes, if the *Mind* can reach them. Now this will hardly be obtained by him who is not well vers'd in the Genealogy of Things.

In the next place, That this Genealogy is abundantly sufficient to supply the place of the *Common Categories* and *Predicaments* of the *Aristotelians*.

By *Predicaments* and *Categories*, they understand such a Series and Disposition of Things, in which the *Superiour* is always predicated, that is, affirmed *Univocally*, that is, according to Name and Thing, of its *Inferiours* in the same *Predicamental Line*. Taking this for granted, as a thing known to all Men, there are many things which I cannot approve of in the Constitution of those *Predicaments*.

First, That they divide *Ens* into *Substance* and *Accident* without any Reason: Forasmuch as an *Accident* is no *Entity*, as appears from the foregoing Definition of *Ens* (A. I.); but rather is something belonging to an *Ens*, according to (B. II.)

Secondly, In that they constitute Nine *supream Genera* of *Accidents*, which they thus reckon up; *Quantity*, *Quality*, *Action*, *Passion*, *Relation*, *When*, *Where*, *Situation*, and *Habit*.

Where first they mistake in this, that they make those to be the *Supream Genera*, and distinct too, which truly are not so; as *Quantity*, and *Quality*: For the greatest part of *Physical* or *Natural Qualities* arise from *Quantity*, *Figure* and *Motion*. Secondly, *Relation* doth not in the least belong to the Genealogy of Things, because it is

X.
The Scope of a Philosopher is, to know the Natures of Things.

XI.
What the Peripateticks understand by Predicaments.

XII.
What is to be disproved of in the Categorical Series.

no absolute thing, but only an Affection framed by Reason, viz. an *Opposition*, with or under some respect. Thirdly, *Action* and *Passion* in Bodies are reducible to Motion, whose Species or Modes they are. Fourthly, The Division of *Ens* into Substance and Accident, invented by *Aristotle*, deviates from the Rules of a good Division; because the Parts of it are not opposite. Fifthly and lastly, If any true *Attributes* of Things be found amongst them, the same may be more fitly deduced from our Genealogy: As for Example, *Quantity* belongs to the first Mode of an Extended Being: *Quality*, if it be Mental, to the Modes of Intellection and Volition; if it be Physical, or Corporeal, to the Fifth Mode of an Extended Being, or to others: *When* and *Where*, to Duration and Place, which are the General Attributes of Things: *Situation* is the Mode of an Extended thing, or the respect of one Body to others, considered as near to it: And *Habit* is the Common Adjunct or Accident of some Things; as of a *Human Body*, or some other.

CHAP. IX.

Of the Whole and Parts, Causes and Effects, Subject and Adjunct.

I.
Some other things necessary to be known in order to clear Perception.

HAVING thus Explained the *General Attributes* of Things, as far as is sufficient for the Knowing of Things in General; if any one further desire to Know Things more distinctly and evidently in *Specie*, and particularly, he must consider the thing either as a *Whole*, consisting of *Parts*; or as an *Effect*, produced by *Causes*; or as a *Subject*, furnish'd with various *Attributes*. For this will be a great furtherance to attain a clear and distinct Knowledge, that is, Perception of any Thing.

II.
The Order of Things here to be treated of.

It follows therefore, that we explain the Notions of a *Whole* and its *Parts*, of a *Cause* and its *Effects*, of *Subject* and *Adjunct*; because from these Notions, the Idea of every thing is absolutely and to the Life express'd in the Mind of him that Thinks.

III.
What a Whole is, and how manifold.

We call that a *WHOLE*, which consists of many things joyned together, or which hath *Parts*, into which it may be divided: For a thing which wants *Parts*, is improperly called a *Whole*. Wherefore the *Aristotelians* are in a Mistake when they say, that the Mind of Man is *Whole in the whole Body*, and *Whole in every Part*; because the *Mind* being an Intellectual Substance, is without *Parts*, and after an Indivisible manner in the Body. Wherefore also an Immaterial Substance cannot be said to be *Whole*, save only Negatively, inasmuch as it doth not admit of *Parts*, or Division. A *Whole* is threefold, *Essential*, *Integral*, and *Universal*. An *Essential Whole*, is that which consists of *Parts*, whereof the one is in the other, as are *Matter* and *Form*: Thus Man consists of *Soul* and *Body*. An *Integral Whole*, is that which hath *Parts* without each other; as a Man's *Body* consists of *Head*, *Hands*, &c. An *Universal Whole*, is any Genus with respect to its Species; as *Animal* respecting Man and Beast: Or a *Species*, referring to its Individuals; as *Man* to *Socrates* and *Plato*.

IV.
What a Part is, and how manifold.

We call that a *PART*, which together with its *Copart*, or with many of them, doth constitute a *Whole*; as the *Soul* and *Body* make a Man. A *Part* is either *Principal*, without which a *Whole* cannot consist; as is the *Head* in a *Human Body*:

Or *Less Principal*, which when sever'd doth only maim the whole, but not destroy it.

Tho' the Word *CAUSE* be of it self sufficiently known to all, and therefore the Explication of it seems superfluous; yet is it commonly defined, *That from whose Being something else follows*: Or, *That which of it self, influenceth something different from it self*. Accordingly, *GOD* the Father is the Principle, but not the Cause of the Son; for the Son is another Person from the Father, but not another Thing, that is, not of another or different Nature.

There are Five Genera or kinds of *Causes*, viz. the *Material*, the *Formal*, the *Efficient*, the *Exemplary*, and the *Final*.

The *Material Cause*, is that out of which things are made or formed; as *Wax* is the Matter of which *Tapers* are made; *Pewter*, the Matter of which *Pots* are made; *Gold*, of which *Guinea's* are made. So that whatsoever is agreeing or disagreeing with the Matter, the same also agrees or disagrees with the Things that are made out of it.

The *Formal* is that which Constitutes another thing and distinguisheth it from all other; as the *Soul* is the Form of Man. But whether the Forms of other things be *Physical Entities*, as they talk in the Schools, or only a disposition of *Parts*, shall be discoursed in the General Part of *Physiology*, where this Point shall be distinctly handled. Both these *Causes* are called *Internal*, because they abide in those Things whose Essence they do constitute.

The *Efficient*, or *Effecting Cause*, is that which produceth another thing; and the same is manifold.

Total or *Adequate*, which alone doth produce the Effect, excluding other Causes of the same Rank; as *God* creating *Adam*, whom he produc'd without the Concurrence of any Other.

But a Father and Mother, or Male and Female, are said to be *Partial Causes*, with respect to the Child they generate; because they need each others assistance, and can do nothing solitarily.

The *Sun* is the *Proper Cause* of *Light*; but only an *Accidental Cause* of the Death of a Man, who is kill'd by too great Heat; because the bad Constitution of his Body, was the occasion of his being hurt by the Heat of the *Sun*.

A Father is the *Near Cause* of his Son; but a Grandfather the *Remote*.

A Mother is the *Effective*, or *Productive Cause* of her Son, because she effects a thing which before did not exist.

A Nurse is only the *Conserving Cause*, because she only effects the Continuation of its Existence, and lends her assistance that it may continue in that Existence, which it hath received from its Parents.

A Father is an *Univocal Cause*, with respect to his Children; because they are of the same Nature with him.

But *GOD* is only an *Equivocal Cause*, with respect to his Creatures; because they are of a different Nature from His, and in Dignity inferior to him.

An Artificer is called the *Principal Cause* of his Work, because he acts voluntarily; but *Instruments*, because they are managed by him, as means subservient to the performing of his Work, are only said to be *Instrumental Causes*: Because tho' there be some kind of Power to work in the Instruments, as

v.
What is meant by the word Cause.

VI.
The division of Causes.

VII.
What the Material Cause is.

VIII.
What the Formal.

IX.
The Efficient.

X.
A Total Cause.

XI.
Partial Causes.

XII.
Proper and Accidental Causes.

XIII.
The Near and Remote.

XIV.
The Effective Cause.

XV.
The Conserving Cause.

XVI.
An Univocal Cause.

XVII.
An Equivocal Cause.

XVIII.
A Principal Cause.

in the *Hatchet* to Cleave, in the *Knife* to Cut; yet can they not produce the said Effects, except they be actuated and applied by another Cause. And therefore are called *Passive*, because they receive their *acting Power* from the *Principal Cause*.

XIX.
An Universal Cause.

The *Water* that springs up into divers *Water-Works* in the Gardens of Princes, and which moves variety of *Machins*, is the *Universal Cause* of their Motion, because it is indifferently forced up into them all: But the Artificial disposition and figure of the Pipes is the *Particular Cause*, which determines the *Universal*, and restrains it to some particular effect.

XX.
A Natural Cause.

Bodily Things, when they act, are said to be *Natural Causes*, because they produce an Effect from a Natural Propensity or Necessity, without any fore-knowing Knowledge; as the *Sun*, *Fire*, and the like: But *Man* is the *Intellectual Cause* of those things which he effects by his Understanding and Will.

XXI.
A Voluntary Cause.

A Man that *Walketh* is a *Free Cause*, because he acts spontaneously, and not by force: But a *Fire* burning *Wood* is a *Necessary Cause*; because where those things are present which are required to its action, as *dry Wood*, application of them to the *Fire*, and *Ventilation* or *Blowing*, it cannot but burn them, neither can it exert any other Action instead of it.

XXII.
A Proper Cause, and without which.

The *Sun*, whilst it enlightens a Chamber, is the *Proper Cause* of the *Light* that is in it: But the opening of a *Window*, or taking down of the *Shutters*, is only a Cause *sine qua non*, or without which such an Effect would not follow; which Cause is also called the *Condition*, without which a Thing cannot be.

XXIII.
A Physical and Moral Cause.

A *Fire* that burns Houses, is the *Physical Cause* of that Burning or Consuming, because the *Fire* properly and of its own Nature burns: But a Man who sets Houses on Fire, or that exhorts or commands others to do so, is only a *Moral Cause* of this Burning; because he hath only Morally contributed to that effect, viz. by Exhorting or Commanding. Thus the *Serpent*, or the *Devil*, was the *Moral Cause* of the Fall of our First Parents.

XXIV.
An Exemplary Cause.

The Form which a Man proposeth to himself in going about to make a Work, is called the *Exemplary Cause*; as the Form which an Architect conceives of a *House* he is about to build; and generally whatsoever can be a Cause of an *Objective Entity*, or of forming any other Image. So he who is the Object of the Eyes or Mind of the *Painter*, is the *Exemplary Cause* of his own Effigies or Likeness.

XXV.
What the Final Cause is.

The *Final Cause*, is the *End* for which any thing is; as when a Man applies himself to his Studies, in order to the attaining of *Learning*: And therefore the *End* is commonly defined, the Cause for whose sake any thing is.

XXVI.
A Primary End.

An *End* is twofold, either *Primary*, which is principally intended; as the *End* of a *Knife* is to Cut; of a *Garment*, to cover the *Body*, and to shield it from the Injuries of the *Weather*.

XXVII.
A Secondary End.

A less *Principal* or *Secondary End* is, which moves one only in a less degree, and is only considered as something Accessory. Thus the *Secondary End* of a *Garment* is to adorn the *Body*.

XXVIII.
The End for whose sake.

That which a Man intends to do, or to obtain, is called the *End for whose sake*: So *Learning* is the End of Studies, *Health* the End of the Phy-

sician's Art, as being that which it intends to procure.

He for whom any thing is desired, is called the *End for whom*: So Man is the *End for whom* of Medicine; because it designs to procure *Health* to him. To form ones *Reason* aright, or to direct the *Understanding* into the knowledge of all things whatsoever, is the *Adequate End* of *Logick*: But to direct the *Understanding* in Natural things, or in the exercise of Vertuous Actions, is the *Inadequate* or *Partial End* of *Logick*.

Whence we may gather, that the *Material Cause* is that out of which Things are made; the *Formal*, by which; the *Efficient*, from which; the *Exemplary*, according to which; and the *Final*, for which things are made.

Whence it follows, that the *Effect* or *Thing caused*, which depends on the Cause, and by virtue whereof it is, is Fivefold; viz. an *Effect*, which proceeds from the *Efficient Cause*: The *Thing designed*, or the *Means* ordained to the *End*: The *Thing materiaterd*, or which consists of the *Matter*, and is made of it: The *Thing formed*, or constituted by the *Form*. To these you may add the *Thing exemplated*, in respect of the *Exemplar* according to which it is made.

That is called a *Subject* to which something is adjoynd, or to which something accrues besides its Essence: So *Cloaths* are put on the *Body*; the *Soul* of Man is joynd to his *Body*; *Writing* is applied to *Paper*.

A *Subject of Inherence*, is that into which something is received: So a *Sponge* is said to be the *Matter* into which the *Water* is received: The *Outside* of the *Wall* is that which receives the *plaster* or *whiting* in it. A *Subject of Adherence* is, which receives another thing upon it self, or to it self, as a *Hand* that puts on a *Glove*. A *Subject Containing*, is that which comprehends any thing within it self; as a *Vessel* doth *Water*, or the *Sheath* doth the *Sword*: Because by *Subject* nothing else is understood here, than that to which something is joynd besides its Essence; or to which something supervenes after its production and constitution.

A *Subject* is sometimes taken for an *Object*; as when we say, to *subject* a thing to the Eyes of any one; that is, to propose a thing to any ones Faculties, that he may act about or in it. So the Object of *Hearing* is a *Sound*, the Object of *Seeing*, *Colour*.

We call that an *Adjunct*, which we consider to be in a thing besides its Essence, as something added, accruing or hapning to it, whether the same bring along with it some proper Reality; as *Fire* in the Pores of hot *Iron*, the *Soul* in the *Body*: Or whether it be nothing else but a Mode of Substance; as *Love* or *Science* in the Mind; *Motion*, *Figure*, *Rest*, *Situation* in a *Body*.

An *Accidental Adjunct* is predicated of its Subject in *Concrete*, and not *Abstractedly*. That is called a *Concrete Adjunct*, which denotes the Accidental form together with the Subject; as *White*, *Learned*, *Great*, &c. An *Abstract Adjunct* is that which signifies only the Accidental or Modal form; as *Whiteness*, *Learning*, *Greatness*. Wherefore an *Adjunct* is predicated of its Subject in the *Concrete*; *Snow* is *white*, *Socrates* is *Learned*, *Great*: But by no means in the *Abstract*; as *Socrates* is *Whiteness*, *Learning*, *Greatness*.

G

To

XXIX.
The End for whom, Adequate and Partial.

XXX.
The Number of Causes.

XXXI.
The Causatum, or Thing Caused is fivefold.

XXXII.
What a Subject is.

XXXIII.
The difference betwixt a Subject of Inherence and Adherence.

XXXIV.
A Subject is sometimes taken for an Object.

XXXV.
What an Adjunct is.

XXXVI.
Adjuncts are only attributed to their Subjects in the Concrete.

To these things thus at large explained, we will subjoin this Rule.

The Sixth Rule of Truth.

XXXVII.
The Sixth
Rule of
Truth.

The Idea or Perception of every thing is by so much the more clear and perfect, by how much the more Parts, Causes and Adjuncts of the thing it doth represent.

For from the *Parts* we have a view of the *Whole*; from the *Causes*, what is contained in the *Effects*; from the *Adjuncts*, as so many *Complements* and *Ornaments*, we perceive the *Nature* of the *Subject*, and its *Qualifications*, especially from its proper inborn *Qualities*.

CHAP. X.

Concerning the Distinctions, whence the Nature and Difference of Idea's is deduced.

I.
What is
the Consent
and Dissent
of Things.

For a more clear understanding of what follows, we will premise something concerning the *Consent* and *Dissent* of Things. Now those things seem to me to *Consent*, which agree in *Common Attributes* and *Logical Notions*; and those to *Dissent*, which do more or less disagree in the same.

The Seventh Rule of Truth.

II.
The Seventh
Rule of
Truth.

Those Things are to be looked upon as Agreeing, which agree in some common Idea or Reason, or whereof the one is included in the Idea of the other; and they are said to disagree or to be diverse, which are the Objects of Different Idea's, and are apprehended after a diverse manner; or the one whereof is not included in the Idea of the other.

III.
Which
Things
agree, and
which do
disagree.

For those things only do *Agree*, which have the same *Genus* or *Species*, or *Parts*, or *Causes*, or *Effects*, or *Subjects*, or *Adjuncts*; or *Agree* upon some other account: Whereas those which *Disagree* in the same, are *diverse* and *dissentaneous*. But those things do most of all *Disagree*, which are separated from each other by opposite *Differences*.

IV.
What dis-
tinction is,
and how
manifest.

Wherefore *Distinction* in *Common* is nothing else, than the *Diversity* we find, between many things. Which *Diversity*, to speak properly, is only to be found between *Existent Beings*: For that which is not, cannot be said to be distinguished. *Distinction* is threefold, *Real*, *Modal*, and *Distinction of Reason*.

V.
What a
Real Dis-
tinction
is.

Real Distinction is that which is found between two or more *compleat Beings* or *Substances*; as between the *Soul* and *Body*, which we know to be distinguished from each other, because we can distinctly know the one without the other: For we can have no more evident sign of *Real Distinction* than this, that we do distinctly and clearly understand the one without the other. I said in the *Definition*, that *Distinction* is a *Diversity*, and not a *Division*; because *Distinction* doth not take away *Union*, but *Identity* only. For tho' the *Soul* be never so closely *United* to the *Body*, yet it continues no less distinct from the same, than if it were actually separated from it: For it is sufficient to make a distinction, if the Things may be separated and preserved apart from each other.

VI.
The Soul
and Body
are Really
Distinct, as
Compleat
Beings.

But you'll object against the Instance of *Soul* and *Body*, that they are only *Incompleat Substances*, and therefore cannot be really distinguished? I answer, by distinguishing the *Minor*. I grant that the *Soul* and *Body* are *Incompleat Substances*, if they be re-

ferr'd to the *Compound* which they constitute. But if by calling them *Incompleat Substances*, you mean that they cannot subsist by themselves: This I deny.

For when we say a *Compleat thing*, we understand nothing else, than a *Substance* furnished with such *Attributes* and *Forms*, as from which we gather it to be a *Substance*: For it is plain, that we do not know a *Substance* immediately, but from its *Attributes*, which because they must be in something or other, therefore we call the *Subject* in which they are, *Substance*. In which respect the *Soul* and *Body* are said to be *Compleat Beings*. The same may be said of all the *Parts* that concur to the making up of a *Whole*. Thus an *Eye*, for Example, is an *Incompleat Substance*, if it be compar'd with the *Body*, whose *Part* it is: But is said to be a *Compleat Entity*, when considered by it self alone; and in like manner the *Soul* and the *Body* are *Incompleat Substances* in reference to the *Whole Man*; but *Compleat*, when they are considered with those *Attributes* by which we know them to be *Substances*.

A *Modal Distinction* is that which is found between a *Mode* and its *Subject*, whose *Mode* it is: So *Figure* is distinguished from a *Bodily Substance*; the *Act of Imagining* or *Willing* from an *Immaterial Substance*, or the *Soul*. For those things we know to be *Modally* distinguished, where the one of them may be conceived to exist without the other, but not on the contrary: As we can easily understand a *Corporeal Substance* without *Motion* and *Figure*, but can by no means conceive *Motion* or *Figure* without a *Body*.

There is another *Modal Distinction* between two *Modes* of one and the same *Substance*: As between the *Figure* and *Motion* of one and the same *Body*, or between a *Substance* and the *Mode* of another *Substance*: But this latter is rather to be called a *Real Distinction*, than *Modal*; forasmuch as That *Mode* may be clearly understood without the other, and hath no dependance on the *Substance*, as not affecting or modifying it.

A *Distinction of Reason*, is that which is found between a *Substance* and some one of its *Essential Attributes*: Thus *Quantity* doth not differ from a *Bodily Substance*, but only by a *Distinction of Reason*; as *Cogitation* from the *Mind*. The *Sign* of this *Distinction* is, when we cannot have a distinct *Idea* of the *Thing*, if we remove from it that *Attribute*, as appears in the Examples alledged. And so likewise, two *Attributes* of the same *Substance* are distinguished only by *Reason*, if they be such as that the *Notion* of the one cannot be clearly conceived without the other; as *Justice* and *Mercy* in *GOD*. And these are said to be *Formally* distinguished, because their *Formal Idea's* or *Definitions* are distinct or diverse.

From what hath been said, we may gather first, What the *Idea's* are which we have of Things; viz. that they are *Conceptions*, or rather the Things themselves conceived and understood by the *Mind*; by which *Intellection* things are said to be *Objectively* in the *Intellect*. So that we can express nothing in *Words*, if we understand what we say, but there must be an *Idea* in us of what we express by our *Words*: Tho' the *Idea* may sometimes be more clear and distinct, and at other times more obscure and confuse; because it implies a *Contradiction*.

VII.
What we
are to un-
derstand
by these
Words, A
Compleat
thing.

VIII.
What a
Modal Dis-
tinction
is.

IX.
How two
Modes are
disting-
uish'd.

X.
Distinction
of Reason.

XI.
What the
Idea's are
which we
have of
Things.

dition for me to know what I say, when I express any thing, and yet to have no other conception of it, besides the bare sound of the words. By the word *Idea* therefore we are to understand; not an Image represented in our Bodily Imagination, and delineated in some part of our Brain, but all that which is in our Mind, when we assert with Truth, that we do conceive a thing, after any manner whatsoever.

XII. *The Ideas we have are not the Product of our Senses.* In the Second place we infer hence, that the *Ideas* of our *Mind*, do not proceed from our *Senses*: For, as was said before, nothing is so clear an object of our *Mind*, as our *Cogitation*, neither is any thing more distinctly known to us, than this Proposition, *I think, therefore I am*: Now we can have no certainty of this Proposition, except we distinctly conceive, what *Being* is, and what *Cogitation* is; and it would be in vain for any to demand any further Explication of these Words from us, since every one understands them, and cannot be further explained without some confusion. But who will say that these *Ideas* of *Being* and *Thinking* are produced by the *Senses*, and have been convey'd to the *Mind*, by the help of *Bodily things*? Wherefore *Ideas* are not to be attributed to the *Senses*, but to the *Mind*, which hath the Power of producing them, and forming them out of it self, without any outward assistance. Tho' indeed the *Mind* be often excited to the producing of them from things that strike the *Senses*: Because this is no more, than in the case of an *Architect*, who may be inclined to Build a House from the Money which is promised him: But it would be very foolish therefore to assert, that Money had been the Original of the House.

XIII. *Clear Ideas.* Thirdly, We may gather that *Ideas* are of two kinds, clear and confused: Because all of them have not the same Evidence, but exceed one another in clearness and distinction. Now those *Ideas* are called clear, which are evident and manifest to our *Mind*, when it gives heed to them; in the same manner as we say that Objects are clearly beheld, when being present to us, they act strongly enough to be perceived by us, and our Eyes are well disposed to behold them.

XIV. *Distinct Ideas.* Those *Ideas* are called *Distinct*, which are so precise, and diverse from all others, that they contain nothing, which doth not manifestly appear, to him that gives heed to them, as he ought. So when a Man feels some great *Pain*, that perception of *Pain*, is very clear to him, but is not always *distinct*: For commonly Men confound it, with their obscure *Judgment* concerning its *Nature*, which they suppose to be in the grieved part, and to resemble the *Sense* of *Pain*, which alone they clearly perceive. And the reason is the same concerning other *Qualities*, viz. *Sound, Colour, Smell, Cold, Heat*, all which they conceive to be in the Objects themselves, and think there is something like these Sensations in the *Senses*, or the *Ideas* we have upon their account. These *Ideas* therefore are called *Obscure*, because they represent things or *Objects*, confusedly or obscurely. Let this therefore be

The Eighth Rule of Truth.

XV. *The Eighth Rule of Truth.* That *Idea*, or perception of a thing is clear and distinct, which represents the thing it self to the *Mind*, according to the foregoing Rules of Truth: And that obscure and confused, which doth more or less depart from the same.

For seeing that that *Idea* is more clear and distinct, which involves least doubtfulness, and which represents more parts and Adjuncts of a thing to the *Mind*, and distinguisheth it from all other things; it must follow that that Perception is clear and distinct, which represents a thing to the *Mind* according to the foregoing Rules.

The Ninth Rule of Truth.

He whose *Mind* is furnished with most, and most perfect *Ideas*, is the most knowing and understanding Man.

For seeing that every thing is made manifest by its *Idea*, and whatever is known of it, is contain'd in its *Idea*, it is clear that the more *Ideas* we have in our *Minds*, the greater must be our Knowledge: And by how much the several Perfections do evidently and distinctly comprehend more particulars, by so much the more excellent and perfect must that Knowledge be.

AN APPENDIX.

Of the Imposition, Signification, Definition and use of Names.

FOR as much as the Names or Words, we use in discourse are Marks and Signs of our Conceptions, and consequently of the things themselves, we have thought fit to add something here concerning their *Imposition, Signification, Definition and Use*, and this by way of Conclusion.

It hath been an enquiry amongst the Philosophers of old, whether the Names or Words we use in Speech, were from Nature, or from Custom, and Consent: Or, which is the same, whether it be natural for all Men to speak those words, by which they utter their Conceptions; or whether they were imposed on things from the free choice of Men, and invented to be put instead of our Conceptions. *Epicurus* ascribes the original of Names to Nature, and asserts them to be effects produc'd by the force thereof. So that the first Men, when they were struck by the Image, proceeding from the Object, and found several Passions of Love or Hatred stir'd up in them, broke forth into some Voices, by which they designed them, no otherwise than if they had pointed at them with the Finger, or some other Bodily Gesture. And accordingly his opinion was, as *Proclus* tell us, Chap. XVII. That Names are as well from Nature, as are the operations of Nature that go before them, as a Vocal Sound, or the Function of Seeing; for that the same thing that sees and hears, must also name the things it sees and hears; So that the Name Nature, is an effect or work of Nature.

For the variety of Names according to *Epicurus*, which is found in divers Nations, is to be ascrib'd to their different Temperaments, who being affected with different Passions, at the perceiving of things, did express one and the same thing diversly, that is, by a different Voice or Sound. Whence it came to pass that those Nations, who had no Commerce with others, still kept their own Idiom; whereas those that had more Communication with others, did take in some of their Words, which were unknown to their Forefathers.

But whatsoever *Epicurus* may alledge to the contrary, the Names of things do not seem to proceed from Nature, but from the consent and agreement

XVI. The Rule explained.

XVII. The Ninth Rule.

XVIII. The Explication of this Rule.

I. Of the Things that are handled in this Appendix.

II. *Epicurus* was of opinion that the names of things were from Nature.

III. Whence the variety of Names proceeds according to *Epicurus*.

IV. Names were imposed from Mens free choice.

ment of Men. As may be proved first from *Homonymy* or *Equivocation*, by which the same word is attributed to divers things; which was occasion'd by Mens joyning the same sound to different *Idea's*, so that the same Sound agrees to many *Things*, not according to the same, but different *Idea's*. As for Example, this word *Vacuum* or an *Empty space*, according to the vulgar use signifies, a place in which nothing is contained, of that which we suppose ought to be in it: As when we say that a Ship is empty, because it hath no lading. But according to *Philosophers*, *Vacuum* signifies a place in which no bodily thing is contained. In the second place, that Names have their original from the voluntary imposition of Men, is apparent from *Polyonymy*, and *Synonymy* which attributes divers words to one and the same thing: As *Liber*, *Codex*, both which signify a Book; *Ensis*, *Gladius* a Sword. Thirdly, The same may be proved from the changing of Words, by which sometimes one Word, and at other times another is given to the same thing: as now *Aristoteles*, afterwards *Plato*; now *Tyrannus*, then *Euphrastus*, and afterwards *Theophrastus*. Which would not happen so, if words owed their use to *Nature*, and not to the voluntary institution of Men.

V.
Words signify diversly amongst divers Nations.

Moreover we find by Experience, that Words have their signification from the imposition and will of Men, forasmuch as the same Word signifies one thing in this Nation, and another in another Nation. For what is more common than for a Name or Word, which before represented nothing to your Mind, now to signify something from the institution of Men? For tho' words must be taken from the People, who have the Power of giving Law concerning them: Yet it is certain, that there is a kind of Speech proper only to those who follow some particular Art or Calling. And tho' as *Philo Judeus* saith, Speech be proper to Man, as *Neighing* to a Horse, *Barking* to a Dog, and *Lowing* to an Ox; yet is not the faculty of speaking Natural, as to the signification of speech, but only with respect to the sound of the Word. For the signification of every word doth not agree to it, by any force of Nature, but wholly depends on the free will of Men.

VI.
Names are the Notes or Marks of our Conceptions.

WORDS therefore being instituted by Men, are the Notes, and Signs of our Conceptions, and therefore of the things themselves; whether they signify our conceptions, or the things themselves. That they signify the inward conceptions of our Mind, appears hence, that whenever we please, we can discover our Secrets, by words to others, they being the Interpreters of our Mind, which represents the image of our Thoughts. The word that sounds without, saith *S. Austin* 15 de Trin. Cap. XI. is a sign of the word, that lies hid within. For otherwise, except Words did intimate our Conceptions, there would be no such thing as a Lye, which consists in this, that the Mind of a Man doth disagree with the words he utters; or when we have other conceptions in our Mind, than our words import.

VII.
Names do also signify the things themselves.

And that Names do also signify the things themselves, we can prove by experience; for because we cannot carry all things with us, we make use of words, for signs whereby to signify absent things. For it is apparent, when any one calls for some particular Person, as for Example, *Socrates*, that the Name by which he calls him forth signi-

fies the thing which *Socrates* is; and when he commands him to come to him, to return answer, that the Thing is meant and not the Words. Hence the Scripture tells us, that GOD set all living Creatures before *Adam*, that he might give Names to them, conform to the Things themselves. So that it appears that Mankind makes use of Words to manifest their Conceptions, and the Things themselves.

But because when Words are wrongly understood by us, it occasions great Confusion in our *Idea's*, and also in our Discourse, therefore we are used to define what we mean by our Words, and to declare what we would have to be understood by them. For it often happens, that one Word, signifies many Things, by which means, the Mind may be easily confounded, by applying it sometime to the one, and sometime to the other *Idea*. For example, The antient *Philosophers* perceiving that there was something in Man, that was the cause of *Nutrition* and *Augmentation*, called it the *Soul*, which *Idea* they afterwards attributed to *Animals* and *Plants*, as finding the same Faculty in them. And discovering also in Man a Principle of *Cogitation*, they gave to it likewise the Name of *Soul*. And so from this Sameness of the Name, they took occasion to confound the Principle of *Cogitation* with that of *Nutrition*, and *Growth*, and took Things wholly different to be one and the same: Which confusion can no otherwise be avoided, than by considering the word *Soul*, only as a Sound, devoid of any meaning, and afterwards bestowing it upon that Thing alone which Thinketh, Saying, I call that the *Soul*, which is the Principle of Thinking in us.

VIII.
To avoid the confusion of Perceptions, we ought to define our Words.

And this is that which commonly is called the Definition of a Name, and is very familiar with *Geometricians*, by whom it is rightly made to be a kind of Principle. For it is in the Power of Men, to denote a certain *Idea* by certain Names or Words, and to apply them to what they have a mind. This being the difference between the Definition of a Name, and the Definition of a Thing, that it is not in the power of the Will of Man, to make the *Idea* contain what they please. For they must needs fall into Error, who going about to define Things, attribute any thing to their *Idea's*, which they do not contain. As for example, If we deprive the name *Parallelogram* of its signification, and no longer consider it, as a Figure including Four sides, but consider it only as a naked Sound, or will have it to signify a Triangle or Figure consisting of Three sides, we may do so, if we please, neither shall we thereby make ourselves lyable to Error, as long as we make use of the word *Parallelogram* only to signify a Figure contained within Three lines. And therefore we may say; A *Parallelogram* hath its Angles, equal to two Right ones, and that the greater Angle in a *Parallelogram*, is subtended by the greater side, &c. But if retaining the signification of the Word, and its ordinary *Idea*, which represents to us a Figure, whose opposite sides are *Parallel*, we should still assert that a *Parallelogram* is a Figure consisting of Three sides, we should fall into Error; for then we should not define a Name, but the Thing; seeing it is a contradiction, that a Figure consisting of Three lines should have its sides *Parallel*.

IX.
What the Definition of a Name is.

From

X.
How the
Definition
of a Name,
is distin-
guish'd from
the Defi-
nition of
a Thing.

From hence it follows. First, That the *Definition of Names* cannot be called in question, because they depend on the will and choice of Man. For it cannot be denied, but that he who defines a *Name*, may give such a signification to the sound of the Word, as best pleaseth him, and maintain that signification, which he puts upon it. But this cannot be in the *Definition of Things*, which frequently are controverted, for as much as they may be false, and represent the thing otherwise, than indeed it is.

XI.
The Defini-
tions of
things may
be doubt-
ful.

In the second place it follows, that since the *Definitions of Names* cannot be questioned, they are therefore to be lookt upon as *Principles*; which cannot by any means belong to the *Definitions of Things*, they being *Propositions*, which can be denied by those who find any obscurity in them, and therefore stand in need to be proved, as other *Propositions*; neither are they to be taken for granted, except they be self-evident, and partake of the clearness of *Axioms*.

XII.
Whence
Errors do
arise in the
common
Philosophy.

Wherefore they who are taught in the *Aristotelean Philosophy*, do doubly mistake, First, By confounding the *Definition of a Thing*, with the *Definition of a Name*, and attributing to the former, what only belongs to the latter; for after that they have alledg'd several *Definitions*, not of *Names*, but of *Things*, which are altogether false, and neither express the *Essence of Things*, nor the *Idea's* which we Naturally frame from them; they will needs have us to consider these *Definitions*, as so many *Principles*, or *Perspicuous Notions*, which no Man is able to gainsay; insomuch that if any one refuse to admit them for *Principles*, they are incens'd, and do not think such a Person fit to be disputed with.

XIII.
The necessity
of Defin-
ing Names.

Secondly, The common *Philosophers* are mistaken, in that they seldom or never have recourse to the *Definition of Names*, to rid them of all obscurity, and to addict them to certain and clear *Idea's*, but leave them in their confusion and obscurity. Hence it is that the greater part of their *Disputations* are no better than Contests about Words; which would be easily removed, if those Words that involve any obscurity were defined, and whatsoever makes their meaning doubtful and uncertain were removed. This will appear more fully by an Example: *Philosophers* suppose that nothing is more evident in Nature than that *Fire* is *Hot*; but except it be first cleared what we are to understand by *Heat*, we shall never know, how or in what regard *Fire* is said to be *Hot*. By *Heat*, therefore they do understand either a certain power, wherewith the *Fire* is endowed, to produce in us the sensation of *Heat*, and in this case they truly apprehend the thing as it is: Or else by *Heat*, they apprehend a certain *Quality*, like to the sensation they perceive, wherein they are mistaken, since that is obscure, neither can it any way be made out how *Fire* is *Hot*, after this manner. For tho' it be clear that the cause of that *Motion* which we experience in our *Bodies*, be in the *Fire*, yet have not we the least ground of evidence, that the *Fire* contains any thing like that which we feel, when we stand near the *Fire*.

XIV.
It is not
necessary to
define all
Names or
Words.

But tho' the *Definition of Names* contributs much towards the clear understanding of *Things*; yet it is not necessary to explain all *Names* by *Definitions*, because that would be often superfluous,

and indeed is utterly impossible. For it is certain that Men have many *Idea's* that are so distinct, that those who understand the same Language, as soon as they hear the *Names of Things*, they immediately form the same *Idea's*. So they who hear those *Names Entity or Being, Cogitation, Existence, Certainty, Equality*, and such like, do immediately apprehend the *Things* that answer to them in their *Minds*; and therefore it is superfluous to explain them by *Logical Definitions*, as being most simple *Things*, and such as are known of themselves. I said also that it was impossible to define all *Names*, forasmuch as to the explaining of any Word, we must make use of other Words, to determin the *Idea's*, to which the Words are addict'd, and those Words again stand in need of other Words to explain them, so that it would be necessary to run into infinite. For this Reason we must keep to Primitive Words, and not easily change those which Use hath made to pass current amongst Men.

They are much in the wrong, who when any Word is to be defined, do not consider what Sense Men commonly attribute to it, and that as far as may be, they are never to recede from it. So he that would put the Name of *Parallelogram* upon a Triangle, would be accounted a Mad-man for his Pains, for contradicting the *Etymology* of the Word, and running Counter to common use and custom. In which regard the *Chymists* are greatly to be blamed, who without the least profit thence ensuing, have changed the Names of *Things*, and assigned others to them, which have no true Affinity at all with those *Idea's* to which they affix them. Thus by the Name of *Sulphur (Brimstone)* they do not understand that Thing, which the Vulgar know and call by that Name, but a *liquid, odorous, oleous and Inflammable Substance*, which is the Glue that joyns the Parts of dry Things together: Neither do they by the word *Mercury*, understand *Quicksilver*, but a certain most subtil and clear Liquor, of an *Acid* or Sourish Taste, which readily Penetrates every where, and easily vanisheth away. And by the name of *Water* they understand another far more copious Liquor, which dissolves *Salt*, which cannot be dissolved by *Sulphur* or *Mercury*. Hence we infer

The last Rule of Truth.

The Names of Things which we use in Philosophizing, must be clear and determinate as to their Signification; not Obscure or Ambiguous.

For seeing that all the Things which we do heedfully Interpret, are delivered by us, in *External Expressions*, the highest excellency whereof is *Perspicuity*, it is necessary that we make use of fit and usual Words for the expressing of Things, and take care to give distinct Names to distinct Things.

XV.
In the use
of words we
are never
to recede
from the
common re-
ceived Sense
and mean-
ing of them.

XVI.
The Tenth
Rule of
Truth.

H

The

The Second Part of Logick.

Concerning the Right Judgment
of the Mind; or Proposition.

CHAP. XI.

Of Judgment, Absolute and Compared.

I.
What
Judgment
is, and that
Affirma-
tion and
Negation
belong to
it.

HAVING thus informed our selves what *Idea's* are, and how they are distinguish'd from each other, the Order we have set our selves in the beginning of this Treatise of LOGICK, requires that we now speak of their *Composition*, whence JUDGMENT, or the Second Operation of the *Mind*, as others call it, doth proceed. And herein consists the whole Sum of our *Knowledge*; because when our *Mind* hath once pass'd a firm and stable *Judgment* of any thing, it thinks it self arriv'd to the very Top of *Science*. To *Judge* therefore, is nothing else, than to assent to those Things, of which we have clear and distinct *Idea's*; or to deny our assent to those things whilst the *Idea's* that represent them are obscure, and are perceived to be so. And therefore *Judgment* is a kind of *Composition*, by which the *Mind* joyns one *Idea* with another by *Affirmation*, or separates it from another by *Negation*: As when from the Perception of the *Sun* and *Light*, he assents that the *Sun* is *Lucid*; or from the Perception of the *Moon* and *Cheese*, denies the *Moon* to be *Cheese*.

II.
To *Judgment* assent
or dissent
is required.

For it is not sufficient to *Judgment*, to know two *Idea's* jointly; but it is necessary, that the one be conceived to be in the other, and that assent be given to *Truth* as soon as it appears: For an *Affirmation* and *Negation* appertain to the Essence of *Judgment*; neither can there be any Judgment without *Assent* or *Dissent*. Wherefore as long as a Man sticks in doubtful Enunciations, to which the *Will* doth not yet yield its *assent*, and being Uncertain, enquires concerning the *Truth* of them, he cannot be said to *Judge*, till after a full determination of his *Mind* he affirms the thing to be, or denies it to be such as he perceives it.

III.
To the right
forming of
Judgment,
it is first
required,
that the
Under-
standing
precede.

To the right Forming of *Judgment*, it is required, First, That the *Understanding* do precede, and that the things be known, before that we affirm or deny any thing concerning them; since we cannot attribute ought to another thing, except we have first perceived them both. Wherefore in every *Categorical* or *Simple Proposition*, it behoves us to have a distinct Perception of the Terms, viz. the *Subject* and the *Attribute*, before we assent to the *Conjunction* of them; in every *Hypothetical*, of the *Connexion* of the *Antecedent* and *Consequent*; in a *Modal*, of the *Mode* and the *Thing said*; in a *Disjunctive*, of the *Repugnance* between the *Antecedent* and the *Consequent*; in a *Copulative*, of their *Simulty* or *Existing* at one and the same time. And the same Caution is to be used in refusing our *Assent* to any Proposition; seeing that Men for want of this Observance fall into great Errors, and judge preposterously of things. How many are there that judge the *Earth* to be plain or level; that the *Moon* has the Figure of a Dish or Platter; that the *Stars* are very Little things, and that the *Sun* is much less than the *Earth*; because they never had a true Perception of any of these things, but trusting to their Infant Prejudices, believe

nothing to be True, but what agrees with the report of their Senses.

Wherefore it is requisite in the next place, for the avoiding of all Mistakes in *Judging*, to take a firm Resolution, not to admit any of those things for *Truth*, which formerly we believed such, before we have called them to a fresh and accurate Account, according to the foreaid Rules or Precepts of clear and distinct Perception; and that we suspend our *Judgment*, till we be certain of their Truth. For he who withholds his *Assent* is thereby secured from Error; and he who assents to what he hath well understood, is so far from being Mistaken, that he embraces and enjoys *Truth*.

In the Third place, To avoid our mistake in *Judging*, we must distinguish between the Things and Occasions in which we are to pass our Judgment: For either we are conversant about the Search of *Truth*, or about the things that belong to *Life*, and which are considered with relation to Practice. If we consider things under the first respect, we must suspend our *Judgment*, when they are not fully known by us, that is, when any obscurity or confusion appears in the things we have under Examination. If we consider them the Second way, we need not make use of so great Precaution, especially when the necessity or opportunity of Business doth not allow us sufficient time for an exact Disquisition; for otherwise we should often let slip an Occasion, before we could resolve our Doubts about the matter. Wherefore in cases where delays are prejudicial, it is best to examine the thing only so far as Time permits, and to embrace what appears for that time clearest and best to us. And having once pass'd our Choice, we are no longer to consider it as Doubtful, in reference to Practice; but as a thing most evident and certain, as if we had been assured of it by a clear and manifest Demonstration.

Compared, or Relative *Judgment*, is between more things, which we refer to another Third thing; in which, if they agree, they are called the Same; but if they disagree, Diverse. For Comparison is not the simple Consideration of one thing, to which we Assent or Dissent; but the Comparing of one thing with another in Quantity or Quality: In Quantity, when we enquire not only of the Dimension, but of the Value, Virtue, or Perfection of a thing; for from hence comes the Equality and Inequality, Greater and Lesser. For things that are compared together in Quantity, are such as have either the same Quantity one as the other, or a greater or lesser.

Things that agree in the same Quantity, are called Even or Equal, because they are compared with respect to something, which is found in the things compared in an Equal Proportion. As at the Equinoxes, the Night is equal to the Day: Hector is equal to Achilles in Bodily Valour. Forasmuch as by the Name of Quantity, is not precisely to be understood Mathematical Magnitude, but any Equality or Inequality, whether it be measurable, or not.

Things that differ in Quantity, are called Uneven, or Unequal; and such are either Greater or Lesser. Things Greater, are such as exceed others in Quantity, or which by their Quantity, exceed the Quantity of those things wherewith they are compared.

Those

IV.
Secondly,
we must
examine
all things
anew.

V.
Thirdly, In
passing our
Judgments,
we are to
distinguish
between
Objects and
Occasions.

VI.
What Com-
par'd, or
Comparative
Judgment is.

VII.
What
things are
even or
Equal.

VIII.
What Un-
even, or
Unequal.
What
Greater.



To the R^t Worshipfull
Knight, their Majesties
Son and Heyre of Henry
near Rippon in Yorkshire
Daughter and Coheyre
of Blencow in Cum-



S^r William Thomson
Sergeant at Law, only
Thomson of Hollin Hall
Gent, by Elizabeth
of S^r Henry Blencow,
berland Knight.

This Plate is humbly

Dedicated by Richard Blome.

IX.
There are
Propositions
Universal,
Particular
and Singu-
lar.

There is another *Distinction* between *Propositions*, which ariseth from the Subjects, that go before the Copular according to which they are called, *Universal*, *Particular*, or *Singular*. An *Universal Proposition* is that to whose Subject a Note of *Universality* is annexed; such as *Every* or *All*, *None*: As, *Every Man has a Soul*; because Man is a common Term, which is taken in its whole Latitude. But when a common Term is only taken in an undeterminate part of its *Extension*, with these Notes; *Some*, *Some Body*, &c. then it constitutes a *Particular Proposition*, whether it Affirm, as *Some Lovers are miserable*; or deny as, *Some Courtiers are unjust*. But if the Subject of the Proposition be Particular, it makes a *Singular Proposition*, as *Charles I. now Reigneth in England*. And this *Distribution* of a Proposition, into *Universal*, *Particular* and *Singular*, is said to be made with respect to *Quantity*, because when any one asks *Quanta* (of what extent) the Proposition is, we fitly answer, that it is *Universal*, *Particular* or *Singular*.

The Second Rule.

Concerning the Judgment of an Universal, Particular and Singular Proposition.

X.
The Second
Rule.

The value of these Propositions is to be Estimated, from the Extension and Limitation of the Subject and Attribute.

XI.
Universal-
ity is two-
fold, Meta-
physical
and Moral.

That we may the more exactly distinguish *Universal Propositions* from Particular, we are to take notice of a two-fold *Universality*, the one *Metaphysical*, the other *Moral*. *Metaphysical Universality*, is when a thing is taken according to its whole Extension, without any Exception: As, *Every Body is Extended*: For this admits no Exception. *Moral Universality* is that which hath Exception; because in Moral Things, it is only minded whether things be so for the most part, as they are declared to be. As if one should say, *All Singers have this fault, that they never will be entreated to Sing, but when not entreated, they can never leave Singing*: Because it is sufficient if it commonly be so. For seeing that such Propositions as these, are not so general but that they admit of Exception, nothing can be rigorously infer'd from them; since it may be false of this or the other particular *Singer*, that he will never be Entreated to Sing, and never cease Singing when not Entreated.

XII.
Proposition
of the Sin-
gulars com-
prehended
under one
Genus.

There are other Propositions that are *Universal de Generibus Singularum*, but not *de Singulis Generum*, that is, of all the Species contained under one Genus; but not of all the Particulars of the same kind: As, when it is said that *all living Creatures were saved in the Ark of Noah*, which is not so to be understood, as if all, of all the Species of *Animals* had been shut up in the Ark, in the time of the *Deluge*; but only that some of all kinds were there saved.

XIII.
Propositions
Indefinite.

Besides the *Universal*, *Particular* and *Singular Propositions*, there are those which are called *Indefinite*, which tho' they have an *Universal Subject*; Yet the same is taken neither *Universally* nor *Particularly*, but *Indeterminately*: As, *Man is a Living Creature*. *A Triangle has Three Angles equal to Two Right ones*. Because no *Universal Note* as *Every*, *None*, or *Particular*, as *Some*, *Some one*, is put before *Man* and *Triangle*.

A Proposition in general is divided into *Simple* and *Compound*. That is a *Simple Proposition*, which consists only of one Subject and Predicate: As, *Man is a Living Creature*. *A Loadstone draws Iron*. *Compound Propositions* are such as consist of more Subjects and Predicates: As, *Peter and John, went up at the ninth Hour of Prayer*. Where this Attribute *went up*, is not affirmed of one Subject, but of more than one, viz. *Peter and John*. And such Propositions as these are Equivalent to two or more Propositions; for if this Proposition were to be explained, we must do it by these two Propositions, *Peter went up, John went up*.

Words *Adjective*, or *Connotative*, make a *Complex Term*, whether they be put alone, or joyn'd with *Substantives*. For the Word *Wise*, doth confusedly signify the thing in which *Wisdom* is; but denotes *Wisdom* distinctly. And when I say, a *Wise Man*, in these two Words a kind of Proposition is contained: For it comes to the same thing whether I say, a *Wise Man*, or a *Man that is Wise*. Wherefore every *Adjective* or *Connotative Term*, doth include a Proposition, which since it accedes from without, to the Proposition called *Principal*, it may be rightly called an *Adjunct*, or *Incident Proposition*.

The Third Rule.

Of the Judgment of a Simple and Compound Proposition.

The Simplicity or Composition of a Proposition is taken from the Combination or Disjunction of the Terms, that is, of the Subject and Predicate, whether the same be single or manifold.

Compound Propositions are of two kinds; for some are such in which the Composition is Evident; others again in which it is more hid, which the Logicians therefore call *Exponibiles*: Of the first sort are Propositions, *Copulative*, *Disjunctive*, *Conditional*, *Causal*, *Relative*, and *Discretive*.

Copulative Propositions are such as include more Subjects and Predicates, joyn'd by an *Affirmative* or *Negative Conjunction*. As when I say, *the Sun and Moon illuminate the Earth*; for here I joyn *Sun* and *Moon* together, and affirm of them both, that they *illuminate the Earth*. For the parts of a *Copulative Proposition*, are entire simple Propositions, which have another Predicate or Subject.

Disjunctive Propositions are those in which the *Disjunctive Note* or, *either*, *whether*, and the like is found; As, *a Man either has, or has not a Child*. *Either the Earth is mov'd about the Sun, or the Sun about the Earth*. The truth of which Propositions, depends upon the necessary Opposition of the Parts, between which no Medium can be assigned. And therefore this *Disjunctive Proposition*, *It is either a Man, or an Animal, is false*, because the Parts are not opposite to each other. As is likewise this, *It is either Peace or War*, because there may be a *Truce* or *Cessation of Arms*, which is a Mean between *War* and *Peace*. So that to the absolute Truth of *Disjunctive Propositions*, it is necessary that they have no Mean at all; but to their being Morally true it is sufficient, if commonly they have none.

Conditional Propositions consist of two Propositions, joyn'd by the *Conditional If*, as; *If God be merciful, he will forgive Sinners*. *If that be a Triangle,*

XIV.
Of Proposi-
tions, some
are Simple
and others
Compound.

XV.
Words Ad-
jective
make a
Complex or
Compound
Term.

XVI.
The Third
Rule.

XVII.
Compound
Propositions
are many-
fold.

XVIII.
Of Com-
pound Pro-
positions
some are
Copulative.

XIX.
Some Dis-
junctive.

XX.
Others Con-
ditional.

IX.
What Les-
ser.

Those things are *Lesser*, which in Quantity are exceeded by others: For the *Lesser* is made use of to set forth the Greater *Excellence, Dignity, Number, or Usefulness* of the other. Thus *Plato* is said to be a more Excellent Philosopher than *Socrates*: *A Dog* swifter than a *Wolf*. A Comparison in *Quality* is, when the *Similitude*, that is, the *Proportion*; or *Dissimilitude*, that is, the *Disproportion* of things is consider'd. Where by the Name of *Quality*, we are not to understand a *Physical* or *Natural*, but a *Logical Quality*; such as is *Affection, Nature, Faculty, Action, Passion, &c.*

X.
What things are
Like.

Hence those Things are called *Like*, which agree in *Quality*; or which being compared together, are found to have some *like Affection or Faculty*. As when we compare the *Sun* and the fix'd *Stars*, with respect to *Light* which is found in them both, we say they are like one another. For things compared are not alike in all things, but differ also in many *Specialties*. But when we compare those parts or respects wherein they agree, from one *Like* we rightly conclude the other, because the *Effects* and *Adjuncts* of like Causes and Subjects are alike, and so on the contrary.

XI.
What Un-
like.

Those things are *unlike* whose *Quality* is diverse; or those are diverse *Comparates*, which differ in *Qualities, Actions, and Passions*. So, *A Wise man* is unlike to the *Moon*; *A Constant man* is unlike to a *Reed shaken with the Wind*. Hence from things that are *Unlike*, *Unlike* things are concluded; because the *Effects* of *Unlike* Causes are unlike, as are the *Adjuncts* of *unlike* Subjects, and on the contrary. Wherefore because a *Reed* is easily driven this way and that way by the *Wind*; and *S. John* is not so easily shaken, therefore in this regard, *S. John* and a *Reed* are unlike. Here we are to take notice, that the *Unlikeness* is to be restrained within the bounds of that *Quality*, wherein the Comparison is made.

CHAP. XII.

What a Proposition is, and how manifold.

I.
What things
make up
a Propo-
sition.

A Proposition, or Enunciation, according to *Aristotle*, is an *Oration or Speech*, which affirms or denies; or an *Oration*, that signifies either true or false. From which Definition it clearly appears, that to every Proposition two *Forms* at least are required; the *One*, of which something is affirmed or denied, which Term is called *Subject*; the *Other*, which is said or denied of another, which Term is called the *Attribute*: As when I say, *God is Existing*; *God* is the *Subject*, and *Existing* the *Predicate*.

II.
The word
Is, joyns
the Predi-
cate with
the Sub-
ject.

But because it is not sufficient to conceive these two Terms, except by our *Cogitation* they be joyned together, or disjoyned; the word *Is*, is the Sign of the *Mind's* affirming, that is, of joyning these two Ideas of *God* and *Existing*, as agreeing together. But when I say, *God is not finite*, the word *Is*, joyned with the Negative Particle *Not*, imports an *Action* contrary to *Affirmation*, or denotes, that we look upon these two Ideas as repugnant; forasmuch as in the conception of *Finiteness* something is included, which is contrary to the Nature of *God*.

III.
A Propo-
sition.

Yet sometimes we express Propositions after another manner: As when we say, *Charles walk-*

eth; Injustice thrives amongst men; because under these words, as well the Connecting word *Is*, as the *Predicate* are contained: And therefore these Propositions are the same as if one should say, *Charles is walking*; *Injustice is thriving amongst men*: Yea, it is customary with *Logicians*, as often as the word *Is*, is used without any *Predicate* following it, to understand the *Predicate* to be comprehended under it: For this Proposition, *Man is*, is resolvable into this other, *Man is existing*. It matters not therefore whether a Proposition consist of Three words, as *Charles is walking*, or of Two, as *Charles walketh*, or One word only, as *Ambulo, I walk*, the Latin word including all the Parts of a Proposition in it.

From this Explication of a Proposition it follows, that all Propositions are either *Affirmative* or *Negative*: For since the Judgment of our Mind is twofold, viz. *Assent* and *Dissent*, Propositions which are the Interpreters of it, must likewise be divided into *Affirmative* and *Negative*. Which indeed is the first and chiefest Division of them, as being taken from the *Copula* or Connecting word it self, or from that *Action* of the *Mind*, which either joyns the *Attribute* with the *Subject*, or separates it from it.

Wherefore concerning the Judgment of an *Affirmative* and *Negative Proposition*, let this be The First Rule.

That is an *Affirmative Proposition* in which the *Subject* and *Attribute* are joyned, or do agree; and *Negative*, in which they are disjoyned, or disagree.

For a Thing is then affirmed to be what it is, when the *Predicate* or *Attribute* agrees with the *Subject*, or when it is one and the same thing with it: As when we say, *Man is an Animal*. But a thing is pronounced not to be, what it is not, when the *Attribute* differs from the *Subject*, and agrees not with it: As when we say, *Man is not a Beast*, because *Man* is declared not to be such, as indeed he is not. This Division of a Proposition is according to *Quality*; because when any one asks, of what kind the Proposition is, it is answered, *Affirmative* or *Negative*.

We are to observe, that in an *Affirmative Proposition* the *Attribute* is to be taken in all its Comprehension, but not in all its Latitude. As when I say, *Every Circle is a Figure*; whatsoever is contained in the Idea or Essence of a *Figure*, the same is affirmed of a *Circle*; but yet the word *Figure* is not taken in its whole Latitude, for it is of much larger extent than that of *Circle*; and therefore this Proposition cannot be simply converted in saying, *Every Figure is a Circle*. Wherefore in this Proposition the *Attribute* is restrained by the *Subject*, and reacheth no farther than the *Subject* doth.

But the case is different in a *Negative Proposition*; as, *No Circle is a Square*: For here the *Attribute* is taken in its whole Latitude; so as that we may say as well, that *No Square is a Circle*, and all *Squares* must be denied of a *Circle*. But the *Attribute* is not taken according to the whole Comprehension of its Idea, as if all the *Attributes* of a *Square*, were to be denied of a *Circle*: For a *Circle* and *Square* agree in the Idea or Notion of *Figure*.

There

tion doth
not always
stand in
need of an
Attribute,
Subject,
and some-
thing to
joyn them
both.

IV.
A Propo-
sition is
either Af-
firmative
or Neg-
ative.

V.
The First
Rule.

VI.
Explica-
tion of the
Rule.

VII.
In an Af-
firmative
Proposition
the Attri-
bute is re-
strained.

VIII.
But not in
a Neg-
ative.

Triangle, is bath three Angles equal to two Right ones. The First, In which the Conditional is put, is called the *Antecedent*, and the other the *Consequent*. And it is to be noted, that the *Truth* of an *Hypothetical* or *Conditional Proposition*, doth not consist in the *Truth* of the *Antecedent* or *Consequent*, but in the *Union* and *Knitting* of them both by the *Conditional If*; for a *Conditional Proposition* may be true, tho' both its *Parts* be false; as *If a Tree walks it hath Feet*.

XXI.
Others Causal.

Causal Propositions, are such as contain two *Propositions*, joyned by the *Causal Conjunctions* *Because*, *That*; As, *A Covetous Man loves no Body, because he confides only in himself.* *Kings are often raised to a Throne, that they may be miserable.* For to the *Truth* of such *Propositions* as these it is requisite, that the one of them be the cause of the other, and therefore both of them must be *True*: For what is false hath no Cause, neither can it be the Cause of another thing.

XXII.
Others Relative.

Relative Propositions, are known by some Note of *Comparison*; as *Where the Treasure is, there is the Heart also.* *A Woman is so far to be esteemed, as she is Vertuous.*

XXIII.
Others Discretive.

Lastly, *Discretive Propositions*, are such in which we frame different *Judgments*, and determine the said Difference by such Signs as these, *But*, *Yet*; As, *Tho' GOD be Merciful, yet he is Just.* *The beloved thing may be separated from a Lover, but Love not.* The *Truth* of these depends on the *Truth* of their *Parts*, and of the separation which is put between them. Tho' both the *Parts* were true, yet because there is no opposition between them, this would be a ridiculous *Proposition*: *A Covetous Man Loves Riches, and yet cannot endure that any one should be Liberal towards the Poor.* A *Discretive* is the only *Proposition* that is excluded from the *Composition* of a *Syllogism*.

XXIV.
Of Propositions some are Subaltern, Contrary, Subcontrary, and Contradictory.

Amongst *Propositions* that have the same *Terms*, and disposed in the same *Order*, but modified with various *Quantity* or *Quality*, are reckon'd up the *Subaltern*, *Contrary*, *Subcontrary* and *Contradictory*. *Subaltern Propositions* are an *Universal*, and particular of the same *Quality*: As, *Every Circle is a Figure*; *some one Circle is a Figure.* *Contrary*, are two *Universal Propositions* of divers *Qualities*: As, *Every Man is Rich, No Man is Rich*; which may be both false. *Subcontrary Propositions*, are two particulars of divers *Qualities*; As, *Some one Man is a Physician*; *Some one Man is no Physician.* *Contradictory* are such as differ in *Quantity* as well as *Quality*; As, *Every Man is a Living Creature, Some one Man is no Living Creature*: Which cannot both of them be true, nor both false.

CHAP. XIII.

Concerning the Truth and Falshood of Propositions.

I.
Truth is found in three things

It is commonly said that *Truth* and *Falshood* are found in these three Things; viz. In the *Mind*, in *Things*, and in *Propositions*. *Truth* is in the *Mind*, as in its *Subject*: So things are said to be true, in the *Divine Intellect*, because they had there from *Eternity*, their objective and known *Being*: Which does not properly place any *Eternity* in them, but in *God*. *Things* are said to be *True*, when they have such an *Essence* as they ought to have, or when they comport with their *Idea*; and

those false which disagree with their *Definition* or *Essence*. So *GOD* answers to that *Idea*, which he himself hath of a *Being*, *Infinite*, *Immensc*, *Eternal*, &c. But the *Sun* is no true *God*, because it differs from that form of *Cogitation* which we have concerning *God*.

The *Truth* of a *Proposition*, consists in this, that it pronounceth a Thing to be such as it is: As when I say, *the Earth is Round*, it is a true *Proposition*, because I Affirm that of the *Earth*, which belongs to it, viz. a *Round Figure*. So likewise when I say, *A Beast is not Rational*, it is a true *Proposition*, because I remove from a *Brute* what does not belong to it. Wherefore *Truth* is said to be the Property of a *Proposition*, and to which it peculiarly doth belong. For since a *Proposition* is either *Affirmative* or *Negative*, that wherein the *Attribute* is affirmed to be in the *Subject*, is *True*, that is, conformable to the *Object*, if it be really in it; and *False* if it be not in it. And so a *Negative Proposition*, in which the *Attribute* is denied to be in the *Subject*, is *True* if it be not in it; but *False* if it be in it.

II.
Wherein the Truth and Falshood of a Proposition doth consist.

The *Truth* which consists in the *Connexion* or dissent of both extrems, is called *Objective*; but *Subjective* or *Formal Truth*, is the *Judgment* or *Act* of the *Mind*, by which the extrems of a *Proposition* are joyned together; or disjoyned as far as the *Judgment* agrees with the thing it self.

III.
Truth is either objective or Subjective, which is also called Formal.

The same *Proposition* cannot be both *True* and *False*, for then *Contradictories* would exist together. For suppose some *Affirmative Proposition*; if it be true, the *Attribute* agrees with the *Subject*; if *False*, it doth not agree. And therefore, if we should suppose it to be *True* and *False* at once, then must it at the same time agree and not agree. Now it is a contradiction that the same thing should agree and disagree with the same thing; or that the same *Attribute* should be, and not be in the same *Subject*. It follows also, that we cannot at the same time Assent to, and Dissent from the same thing, because both those *Judgments* are opposite, and that the one excludes the other: Which would happen, if the same *Affirmative Proposition*, were at the same time *True* and *False*; for we should assent to it, if the *Attribute* did agree with the *Subject*; and should deny our assent, if it did not agree; which plainly implies a *Contradiction*.

IV.
One and the same Proposition cannot be true and false at one and the same time.

If you object, this *Copulative Proposition*, *Claudius and Theophilus Gaze upon the Stars*, when only one of them beholds the *Stars*, will be both *True* and *False*; seeing it is *True*, that the one beholds the *Stars*, and the other not. I answer, that this *Proposition* to speak absolutely is *False*, forasmuch as *Copulative Propositions* import a *Sameness* of *Time*, and their *Truth* depends on both extremes, so that if one of them doth not agree with its *Attribute*, it renders the *Proposition False*. As, suppose any one should say, *A Good Life and Riches are necessary to Salvation*, this *Proposition* would be *False*, because that tho' a *Good Life* be necessary to *Salvation*, yet *Riches* are not. But if we take this *Proposition* without including any *Sameness* of time; then it will furnish us with two *Mental Propositions*, and so it will be *True*, *Claudius Gazeth on the Stars*, and *Theophilus* does not; and on the contrary.

V.
An Objective answer.

Tho' it be necessary that all *Propositions* be either *True* or *False*, yet are not all equally true and certain: Or which is the same, the *Attributes* do not agree with the *Subjects* in the like degree of necessity.

VI.
Propositions necessarily true, and necessarily false.

necessity. For some *Attributes* are after that manner in their *Subjects*, that their *Subjects* cannot be without them: As *Extension*, with respect to *Bodily Substance*; *Cogitation*, in reference to the *Soul*: And therefore this Proposition, *A Body is an extended Substance*; *A Soul is a thinking Substance*, are called necessary, because their Predicats and *Subjects* are united by an Indissoluble Band. Whereas other *Attributes* are at such a distance from those *Subjects*, that its impossible for them to agree with them, as a *Stone* with relation to *Man*; *Unevenness* with respect to the Number *Two*; and therefore these Propositions, *Man is a Stone*; *The Number Two is Uneven*, are said to be necessarily false; because there is a manifest Repugnance, that the Predicate *Stone* should agree with *Man*, and *Unevenness* with the Number *Two*. Both these kind of Propositions, by reason of the immutable Consent or Dissent of their Terms, are said to be of *Eternal Truth*.

The Fourth Rule.

Concerning the Judgment, or a Proposition necessarily true or false.

VII.
The Fourth
Rule.

That Proposition, whether Affirmative or Negative, is true, wherein things to be joyned, because of the immediate and indissoluble Band of the Terms, that is, of the Subject and Predicate, are conjoyned universally of themselves, and reciprocally; or are disjoyned, because of the impossibility or repugnancy of their Terms. And on the other hand, That Proposition is false, wherein Things to be joyned are disjoyned, and things Dissentaneous conjoyned.

VIII.
The Rule
explained.

For seeing that *Objective Truth* consists in the Agreement or disagreement of both Extreams, viz. of the Subject and Attribute, it must follow that that Proposition in which things consentaneous are Conjoyned, because of their indissoluble Connexion, is necessarily true: As, *Man is a living Creature*; because *Man*, without a living Creature, cannot be. And, *Man is not a Beast*, is necessarily true; because it is repugnant that *Man* should partake of the Nature of a Beast. In like manner these Propositions, *Man is not a living Creature*, and *Man is a Beast*, are necessarily false; because it is a contradiction that living Creature should be separate from *Man*, or that *Man* should be a Beast.

The Fifth Rule.

IX.
The Fifth
Rule.

That Proposition, whether Affirmative or Negative, is contingently true, wherein the Subject and Attribute do only sometimes agree, or not agree, because of their separable connexion; and that false, in which the thing is otherwise exprest than it is, whether it be propounded Affirmatively, by conjoyning things which are to be disjoyned; or Negatively by disjoyning things to be conjoyned.

So this Proposition, *The Air is enlightned*, or *Man runs*, is only contingently true; because the Subject in the first Proposition, viz. *Air*, may be without its Attribute, as being but sometimes enlightned: And the Subject in the second Proposition, viz. *Man*, may likewise be without its Attribute, seeing it is but sometimes that he Runs. But if any one, whilst the *Air* is enlightned, should say the *Air* is not enlightned, the Proposition will be false; be-

cause he separates *Light* from the *Air*, which then agrees to it: Or if when it is dark, he should say, *The Air is Light*; because he joyns things that ought to be disjoyned.

Hence it appears, what is a probable Proposition and Opinion, as also what Science and Error is. For seeing that the probability of a Proposition consists in this, that it approacheth more to Evidence than Obscurity, that Proposition is to be accounted probable to which the Mind assents, because of the likelihood there is of the Attributes agreeing with the Subject, or on the contrary, of the Attributes disagreeing with the Subject. Whereas Science is, when the Truth of a thing is certainly and evidently perceived by Reason. For since the certainty of a Proposition depends of its Evidence, that Proposition is accounted certain to which the Mind firmly adheres, and whose Attribute it judges doth necessarily agree with the Subject. And lastly, Error is, when the Mind assents to a false Proposition for a false Reason, which it apprehends to be a true one.

There are other Propositions, which tho' they be neither necessarily true nor false, yet must needs be either true or false disjunctively; such are those Propositions whose Predicats do only contingently agree with their Subjects, and may be absent or separate from them: As, *Rich*, *Powerful*, *Married*, &c. with respect to *Man*. Wherefore these Propositions, *Cræsus is rich*; *Caligula is powerful*; *Thomas is a Husband*; are said to be Contingent, that is, they are true in such a manner, as that they may be false; and yet it is necessary for them to be either true or false separately: Because every Proposition, in contingent matter, is either true or false disjunctively, that is, cannot be deny'd to be either true or false. It may indeed be deny'd, that such a Proposition is necessarily true or necessarily false; but it cannot be deny'd, but that it is true or necessarily true, or necessarily false disjunctively.

A true Proposition in Contingent Matter, cannot be changed into a false one. Which is thus proved; because if this Proposition, for Example, *John walketh*, be true, tho' but in one instant of time, yet it cannot be said to be false in that very instant wherein it is true: But it is true at one instant; therefore for that instant it cannot be false. Moreover, this Proposition considers *John walking* such a time, at which time wherein he is supposed to walk, it is always true; or if it signifie another time, in which it may be *John doth not walk*, in that case the Object is changed, and therefore is not the same, but another Proposition.

If you say, That during the Time wherein this Proposition, *John walks*, is pronounc'd, *John*, who before walked, may cease from motion, and rest; and thus this Proposition, *John walks*, which before was true, will be changed into a false one.

To this I answer, That tho' at that time wherein this Proposition, *John walks*, is pronounc'd, *John* may cease to walk; yet the Proposition continues true notwithstanding, if once it was true: Because it either determines the time wherein he walks, or that wherein he did walk, and in this respect the Proposition is true; or else absolutely denotes some difference of time in reference to which it is verified, and therefore with respect to that Time wherein he hath walked, is true.

X.
What Opin-
ion, Science
and Error
is.

XI.
Contingent
Propositions,
are dis-
junctively
necessarily
true or
false.

XII.
A true
Contingent
Proposition,
cannot be
changed
into a false
one.

XIII.
Objection.

XIV.
Answer.

The

XV.
Propositions
concerning
a future
Contingen-
cy, have a
determin-
ate truth
or falshood.

The Difficulty is greater concerning the truth of Propositions of a future Contingent: For it is evident enough, that of opposit Propositions of the Present time, one is true and the other false: As, *Peter speaks*, and *Peter doth not speak*: But it may be doubted, whether the same truth be found in those Propositions that respect the Future time; As, *Peter will speak to Morrow*; *Peter will not speak to Morrow*. But it seems certain, that Propositions of a future Contingent, have a determinate truth or falsity: For supposing *Peter* to exist, these two Propositions, *He shall speak*, *He shall not speak*, are contradictory: Now as two Contradictories cannot be together, so it is impossible they should be both of them true, and therefore one or other must be true only; and therefore *Peter will either speak, or not speak*; if he does, the Proposition is true; if he does not speak, it is false: So that one of them is determinately true, and the other false. Again, such as are the Propositions of the Present or Past time, with respect to *Truth*, or *Falshood*, such are the Propositions of the Future: But one of these is determinately true, and the other false; *Therefore, &c.* The Major is clear: For he that pronounceth that a thing will be, and that it will not be, doth speak as true, as he who pronounceth that a thing is, and that it is not; or that a thing was, or that it was not, because it is necessary that one of them must come to pass.

Neither doth it hinder, that we know not which of the Propositions be true, and which false: Because the Truth of Propositions doth not depend upon its being known, or unknown; but upon the Being, or not Being of the thing. Besides, it is certain, that GOD knows which of them is true, and that he can reveal the same to whomsoever he pleaseth.

CHAP. XIV.

Of Division, and Definition.

I.
Transition,
or Connex-
ion of the
following
Matter,
with what
goes before.

HAVING explained the Nature of Propositions, and clearly and distinctly unfolded their Affections of Affirmation and Negation, Universality and Particularity, Truth and Falshood; it only now remains, that we add something concerning Distribution and Definition, which are accounted the most Scientific, or conducive to Science of all other Propositions; and are nothing else, but Tokens or Instances of a clear and distinct Perception; or, if you will, they are Primary Enunciations, Axioms of solid Judgment, and Maxims worthy of all belief.

DIVISION therefore is the Distribution of some Whole into Parts; As, of a *Living Creature* into *Man* and *Beast*; of *Number* into *Even* and *Uneven*. Now Division will not a little conduce to our acquiring a clear and distinct Knowledge of Things, if so be we know how dexterously to make use of it. For seeing that almost in every Object there are many things to be considered, which because of the Difficulties wherewith they are involved, cannot be clearly apprehended by us; it is needful to resolve them into Parts, that so having by Division removed all Confusion, the Particulars may more clearly appear such as they are.

Division is twofold, the one *Real*, the other *Mental*: The *Real* is, whereby a Whole is really and indeed divided into Parts; as a *House* into the

Roof, Walls, Foundation, &c. of which it consists. A *Mental Division* is, when we divide a Whole only by the help of our Understanding: As when we consider in GOD, his Goodness, Omnipotence, Eternity. For it doth not always follow, that the thing which our Mind distributes into Parts, is compounded and divisible; but that only our Conception of it is compounded, and unable to understand so many Attributes under one and the same Notion.

Division is manifold, according to the threefold kind of a Whole and its Parts. For it is either of the Whole Genus into its inferior Species, or of the Species into its Individuals: As the Division of Substance into Mind and Body; of Mind, into an Angel, or Man's Soul: The other is of an Integral Whole into its Parts; which is properly to be called Partition: As the Division of the Body of Man into Head, Teeth, Hands, and Arms. The third and last, is the Division of an Essential into its Essential Parts; as the division of Man into Mind and Body. And these Three are called Primary Divisions.

There is this difference between the two former Divisions: In the Division of a Genus into Species, and of a Species into Individuals; the thing Divided may in the Nominative Case be predicated, of the several Parts that divide it: As when *Living Creature* is divided into *Man* and *Beast*, *Living Creature* is expressed in the Nominative of Man and Beast; as *Man* is a *Living Creature*; a *Beast* is a *Living Creature*. But in the Division of an Integral into its Members, the thing divided cannot be predicated of the Dividing Members, but in an Oblique case; as when a Body is divided into *Head, Breast, Belly, &c.* it cannot be pronounced of the Parts, but in an Oblique: For we cannot say, *the Head is the Body, the Belly is the Body*, but part of the Body. And the reason of this difference is, because the whole Essence of the Genus is included in the Species, whereas the Nature of the Whole is not in every Part.

The other Divisions are called Secondary; as a Division of an Accident into the Subjects, in which it is found. As if we should say of the things that are moved, one is the *Earth*, another is the *Moon, &c.* A Second, is the division of a Subject into its Accidents; as when a Subject is ranged or distributed according to its Accidents. As for Example, Some men are Learned, others Ignorant; some Good, and others Wicked. The Third, of an Accident into its Accidents; by which an Accident is divided, not by its own Differences, but by other Accidents of a different kind: As when we say of *White things*, some are hard, others soft, &c.

Moreover, there are some Conditions required to the constituting of a right Division. First, That all and every one of its Parts be exactly enumerated, without omitting any that belong to it; so that the Dividing Members may exhaust the Divided Whole, and neither be more extended or contracted than it: As, *Even*, and *Uneven*, do comprehend the whole extent of this Term, *Number*, seeing there is no Number which is not in it self either Even, or Uneven.

The Second is, That both parts of the Division, be as far as may be expressed in positive Terms. For the Attributes of a thing that is distributed, may

IV.
The Pri-
mary Di-
vision of
Genus and
Species;
and of an
Integral,
and Essen-
tial Whole.

V.
The Differ-
ence be-
tween the
Division of
a Genus
into Spec-
ies, and of
a Whole
into its
Members.

VI.
The Secun-
dary Divi-
sion of an
Accident
into Sub-
jects, or
contrari-
wise.

VII.
Conditions
of a good
Division.
The First.

VIII.
The Second.

II.
What Di-
vision is.

III.
Division
is either
Real, or
Mental.

may be better understood by *Positive Terms*, than by *Negative*. I add, *as far as may be*, because it sometimes happens, that the *Positive Thing* wants a *Positive Name*, and so we are forced to use a *Negative* in the dividing of it : As when we divide *Living Creature* into *Rational and Irrational* : Or *Substance* into *Material and Immaterial*.

IX.
The Third.

The Third Condition is, That the Whole be distributed into its nearest *Parts* : According to this Rule, it would not be well done to divide *Substance* into *Rational and Irrational* ; because these are not immediately contained under *Substance*, but under *Living Creature*.

The Sixth Rule.

Of the Judgment of Distribution.

X.
The Sixth Rule.

That *Distribution or Division* is the most perfect of all, which doth honestly and equally divide a *Whole* into its *Parts* ; whether it be a *Genus* into *Species*, or an *Integral* into its dividing *Members*, or a *Subject* with respect to its *Accidents*, or an *Accident* into the *Subject*, to which by the Right of *Division* they belong.

XI.
Explication of the Rule

Thus the most perfect *Distribution* of a *Genus* is, when all its *Species* are *Enumerated* : As if one should say of *Living Creatures*, some *Walk*, others *Fly*, others *Swim*, others *Creep*, and others are *Plant-Animals*. An *Integral Whole* is well divided, when all the *Parts* that constitute it are instant'd : As the *Parts* of a *Man* are, *Head, Breast, Belly, Arms, Legs, &c.* That is a perfect *Distribution* of a *Subject*, with respect to its *Adjuncts*, when the *Adjuncts* are reduc'd to certain *Heads*, and these again subdivided into others : As when we say, In *Man* there are some *Adjuncts* of the *Soul*, and others of the *Body* ; those of the *Soul*, are *Knowledge, Virtue, &c.* those of the *Body* are *Health, Beauty, Tallness, Strength, &c.*

XII.
What a Definition is, and of what Parts it consists.

DEFINITION is that which manifests the Nature of Things, shewing why they are, and how they are distinguished from others. There are two things principally that constitute a *Definition*, *Genus* and *Difference*. By the first we understand the agreeableness which the *Thing Defined* hath with others, that are of the like nature with it. By the *Difference* we are informed, how it differs from the same, and what Rank it keeps amongst *Real Beings*. As for Example, when we define *Man* to be a *Reasonable Living Creature* ; by a *Living Creature* which is the next *Genus* of *Man*, we understand something that is common to other things like unto us, viz. the *Beasts*. And by *Reasonable*, which is the *Difference*, we clearly perceive our Distinction from them ; forasmuch as no *Beasts* are partakers of *Reason*. *Definition* therefore is that, which by exhibiting the *Essential Parts* of the *Thing Defined*, expresseth its Nature ; as in the foregoing Example.

XIII.
In Definitions we must make use of the nearest Genus.

We are to observe, that every *Genus* is not sufficient to lay open the Nature of a *Thing*, but the Nearest only : Partly, because it contains all the *Genera* above it, so that by expressing it we include all the rest : For he that affirms *Man* to be an *Animal*, doth consequently affirm him to be *Living, Corporeal* and a *Substance*, and whatsoever else can be imagined higher. Partly, because there is no other *Genus* can more fitly be joyned with the *Specific Difference*, than the nearest, nor which doth more correspond with it.

Amongst *Definitions* some are *Essential*, which properly deserve the Name of *Definition* ; and are those which are explained by their *Essential Degrees*. By *Essential Degrees*, I mean *Essential Attributes*, which constitute the Nature or *Essence* of a thing. And these are only *Genus* and *Difference*, as, *Animal* and *Reasonable* with respect to *Man*. Other *Definitions* are *Accidental* and, less exact, which express the thing by some *Properties* or *External Causes*, as when we define *Man*, to be a *Creature made after the likeness of God*. For tho' *Property* be an *Essential Attribute*, yet not in that Sense as if it did constitute the *Essence* or Nature of a *Thing*, but because it immediately follows the Nature of a thing already constituted : As, *Partition* and *Mobility* with relation to a *Body*. Wherefore the first *Definition* is called a *Perfect Definition*, because it consists only of *Causes* that do constitute the *Essence*, and by them doth most fully and perfectly lay open the Nature of the thing : Whereas the second *Definition* is called imperfect, or a *Description*, because it defines and explains the *Thing* by other ways, than by its *Causes*.

Yet we are not to think, that all things that are objected to the *Mind*, may be comprehended in a *Definition* ; but it is required, that the *Thing* which is to be defined be *One*, that is of one *Essence* ; for those *Things* which involve a manifold Nature, cannot be manifested by a *Genus* and *Difference*. The Second is, That it be *Universal* ; for seeing that *Definition* is a Declaration of the Nature of a *Thing*, it is necessary that we divest it of all particular Circumstances, that it may be viewed such as it is. Thirdly, No *Universal Nature* but a *Species* can be exactly defined ; and that because nothing but a *Species* can consist of a *Genus* and *Difference* ; and therefore seeing that the *Supream Genus* does want them, it follows that the *Things* which are defined must be either *Species* of the lowest Rank, or Intermediate : Which also will but be obscurely defined, without their *immediate Genus* and nearest *Difference*.

There are *Rules* and *Precepts* of a right *Definition*. First, That the *Definition* must be of the same extent with the *Thing* defined, and agree to all those things which the *Thing* defined agrees with. As for Example, because *Animal* agrees to a *Man*, therefore a *Corporeal Substance* endowed with *Life, Sense* and *Motion*, which is the *Definition* of an *Animal*, must agree to *Man* also.

Secondly, That nothing be wanting or redounding in the *Definition*, but that only those Words be made use of, that are necessary for the explaining of its Nature : Wherefore this *Definition* of a *Man*, That he is a *Reasonable, Mortal Animal*, is Superfluous, because the Word *Mortal* is not needful to the *Definition* of a *Man*.

The Third, That the *Definition* consist of that which is more known : For seeing that a *Definition* is declarative of the *Essence*, it must therefore employ clearer Terms ; lest we should be guilty of endeavouring to explain an unknown thing, by that which is more unknown, and so instead of attaining a clear and distinct Perception, should fall into Obscurity and Confusion. Wherefore the common *Definition* of time, that it is, *The Number or Measure of Motion*, cannot be good, seeing it is evident, or apparent, that *Time* doth as well Measure Rest, as *Motion*, since we say, as well that a thing hath rested so long, as that it hath been in *Motion* for that time.

XIV.
Of Definitions some are Essential, others Accidental.

XV.
What things are required to a perfect Definition.

XVI.
Rules of a right Definition. The First

XVII.
The Second

The Third

The



To the Worship-
Vincent of Fetcham
of Surrey
This Plate is humbly



= full Thomas
in the County
Esq. ~~xxxxxx~~
Dedicated by Rich: Blome.

The Seventh Rule.

Concerning the Judgment of Definition.

XIX. The Seventh Rule. That Definition is the most perfect and consummate of all others, which defines the Thing by its Essential Attributes, or constituent causes of its Nature and Essence.

As if one should define the Soul to be a Cogitating Substance, or a Body to be a Substance consisting of three Dimensions. Because Substance as the Genus doth constitute the Soul and Body; and Cogitation as the Difference, distinguisheth the Soul from the Body; As Extension in Length, Breadth and Depth, doth difference the Body from the Soul: Neither is there any thing else required to the understanding of them both.

The Third Part of Logick.

Concerning the Minds Ratiocination, Syllogism.

CHAP. XV.

Of Reasoning or Argumentation.

I. What it is to Reason or Discourse. HAVING spoken of Ideas which represent Substance, and their Modes, and concerning the Judgment and Axioms which arise from their Connexion, it now remains to explain what Reasoning or Ratiocination is, or that Judgment, by which from one Axiom, another is gathered or inferred. For to Reason is nothing else than from a thing known to derive the Knowledge of another: And Reasoning is nothing else, than the Knowledge of one thing deduc'd from the Knowledge of another: As when a Man infers the Heaven to be extended, because all Bodies are extended. And therefore this Judgment is called *Dianoëtick* or Discursive, because the Mind by it runs from one thing to another, and from the Antecedent is lead to the Consequent.

II. What it is that Argumentation superadds to Judgment. Wherefore as Judgment, or the second Operation of the Mind, superadds to the first, which is Perception, Assertion, that is, Assent or Adhesion to Truth: So Ratiocination adds to them both, Deduction, Illation, &c.

III. What things are to be minded in Discourse. In every Argumentation there are two Things chiefly to be minded, the Question it self, that is propounded, and the Argument or Reason that proves the same, or which confirms that which is doubtful, by those things that are certain and evident, and from the Question produceth an undoubted Conclusion. Accordingly in every Argumentation there are two things, that which infers, and that which is inferr'd; that which is gathered, and that from whence it is gathered, howsoever these parts may be disposed or exprest.

IV. Ratiocination contains two Parts. Hence it is that every Argumentation consists of two Parts, viz. of an Antecedent and Consequent, or the Part inferring and that which is inferr'd. That goes before for the confirming of something else; this follows and is gathered from the former: As, when I say, *An Angel is Immaterial*; and therefore is *Indivisible*. For the first Part, viz. *An Angel is Immaterial*, is the Antecedent, and the other, *An Angel is Indivisible* is the Consequent: And the word *Therefore* is the Sign of the Inference, or formal Consecution.

V. The Pre. It is requisite to the Notion of an Antecedent,

from which a certain Conclusion may be deduced, that it be better known and more evident to us; for otherwise it will not conduce to that which we would infer thence. For the Order of Science requires, that beginning from the Easiest things, we proceed by degrees to those which are more difficult to be known. Wherefore, to discourse readily, it is needful that we have ready at hand a Stock of many Axioms, Springing from the Complexion of the Things we have clearly and distinctly conceived, that may serve us instead of Principles, and by whose helps we may arrive to the knowledge of things more abstruse. For we must not promiscuously make use of any known and certain Propositions to infer any thing; but it is requisite that between them there be some Connexions by means whereof, this rather than any thing else may be gathered or inferr'd from it. Because there is a Consequence assigned to every Argumentation, yea a necessity of Consequence, which doth not only depend on the Order of Knowledge, but also on the Natural Connexion of the Things that are to be known.

All Argumentations have not the same force; for seeing that the Judgments of which they are compounded, have not the same Connexion, they must needs according to the variety of Propositions, produce various kinds of Reasoning. For Consequences that are deduc'd from Contingent Premises, cannot have so great Truth and Certainty as those, which are inferr'd from Necessary Premises, and which cannot be otherwise. By Example, this Proposition, *Sempronia Loves her Childeren*, deduced from this Antecedent, *every Mother Loves her Childeren*, differs from this, *Peter is an Animal*, which is deduced from this Antecedent, *A Man is an Animal*: Because the certainty we have that a Man is an Animal, is Metaphysical; Seeing we cannot conceive a Man any otherwise. And therefore this Proposition, *A Man is an Animal*, is so True, that it can never be false: Whereas the certainty we have, that Mothers Love their Childeren, is only Moral, since it can happen that some Women may not Love their Childeren.

An Argumentation in general, is a Speech wherein from certain Propositions expressly or tacitly premised, An other Proposition distinct from those premises is necessarily inferred, by Reason of the due Disposition of them.

If there be just three Propositions in the Argumentation, The first is called the Major, because in it the Major Term is disposed with the Mean or Medium. And by some it is called only The Proposition, by way of Excellence, because it propounds the Foundation of the whole Argumentation.

The Second is called the Minor, in which the Minor Term is disposed with the Medium. It is by some called Assumption, because it is assum'd or taken in as a help, to infer the Third, or Conclusion.

The Third is called Conclusion, in which the Minor and Major Terms are disposed. And is by some termed the Question, because it contains that whose Truth was enquired after, as also the Inference or Consequence, because it is inferr'd and follows from what went before, and that by the illative Conjunction *Therefore*, &c.

The two first Propositions are called Premises, because they must Precede the Conclusion, at least in our Conception, in as much as it necessarily follows from them; because it is impossible, supposing

misses may be more known than the Conclusion.

VI. Reasonings or Argumentations differs in Truth.

VII. The Definition of an Argumentation in general.

VIII. What the Major Proposition is.

IX. What the Minor is.

X. What the Conclusion is.

XI. The two Propositions must go before in every Argumentation.

the Truth of the *Premises*, that the *Conclusion* should not be true. Yet it is not necessary, that in every *Argumentation* the *Premises* should be expressed, since frequently one alone is sufficient, to make the Understanding, tho' somewhat confusedly, to conceive both. For he who from this Antecedent, *Every Stone is a Body*, deduceth this Consequence, *A Diamond is a Body*, had a confused Knowledge thereof in the Antecedent, wherein it is implicitly contained. And he that from this Proposition, *A Body is a Substance*, infers, that *A Diamond is a Substance*, by knowing it to be a *Body*, knows it to be a *Substance*.

XII.
In every
Argumentation
are found
three Ideas.

Every *Argumentation* consists of three Ideas; the *Minor Extream*, or *Idea*, which is the Subject of the Question, or Conclusion, and is also called the *Minor Term*; because the Subject is of less extent than the Predicat: The *Major Extream*, or *Idea*, which is the Predicat, and which is also called the *Major Term*, because it is of larger extent than the Subject: And the *Mean*, or *Medium*, which is twice put in the *Premises*, and is that which joyns both *Idea's* together; as in this *Argumentation*:

*Every Intellectual Substance is Cogitative,
The Mind is an Intellectual Substance;
Therefore the Mind is Cogitative.*

Here *Intellectual Substance* is the Middle Term; *Cogitative*, the Major Extream; and *Mind*, the Minor Extream.

XIII.
Why there
are three
Ideas required
in every
Argumentation.

The Reason why these Three are required in every *Argumentation* is hinted by *Aristotle*, when he saith, That we meet with Three things in every Science, or *Demonstration*, viz. the Subject, of which the Attribute is demonstrated: The Property it self, or Attribute, which agrees with the Subject; and the Reason, or Principle, which makes out this Agreement of the Affection with the Subject. So that the Subject, of which the Demonstration is made, is the *Less Extream*; the Attribute, or Affection, which is prov'd, the *Greater Extream*; and the Common Term, wherewith the Subject and Attribute are joyned together, is the *Argument*, or Middle Term.

XIV.
The matter
explained
by an Example.

For Example: This Question is propounded to be explained, whether the *Earth* be Round; and the thing required is, That from the Doubtful Question a certain Conclusion be deduced: The *Earth* is the Subject or Minor Extream; Roundness is the Affection, or Property, to be demonstrated; and I am to find out a *Medium*, by which it may appear that the Attribute agrees with the Subject. Which may be this: That the Shadow of the *Earth*, as appears in a Lunar Eclipse, is Round, for the Shadow intimates the figure of *Opaque Bodies*: From which accordingly this *Syllogism* may be framed.

A Body whose Shadow is round, must it self be round also.

*But the Earth is a Body, whose Shadow is round.
Therefore the Earth is round.*

XV.
Sometimes
more than
three Ideas
are found
in an
Argumentation.

But notwithstanding that an *Argumentation* is made up of three Propositions, yet many more may be added to them, without any Redundance or Defect; as long as the Precepts of *Ratiocination* are but observed. For if the *Third Idea*, which we have taken to discern whether the Attribute agree with the Subject, or be removed from it, after having compared it with both the Ex-

trems, do not give us a clear discerning, whether it agree with it or no; we may assume another *fourth Term*, to procure a further clearness; and if that be not yet sufficient, may proceed to a *fifth*, until we come to some Term, which may joyn the Attribute of the Conclusion with the Subject. As, supposing a Man should doubt whether *Courtiers* be miserable, he may consider that *Courtiers* are subject to many Passions, as *Ambition*, *Envy*, &c. and if he thinks this not to be sufficient, to prove them to be miserable, he may further examine what it is to be subject to *Ambition*, *Envy*, &c. which if he does, he shall find that it is continually to hanker after Honour, to be grieved at the prosperity of others, &c. and that such a Condition as this cannot but be obnoxious to many Miseries; whence he may form this *Argumentation*: *Courtiers are tormented with Ambition and Envy, and they that are so, are in continual Trouble, and they that are in continual Trouble, are miserable: Therefore Courtiers are miserable.*

Argumentation in General, is divided into Perfect, and Imperfect. Perfect *Argumentation* is a *Syllogism*, which forasmuch as it consists of Three Propositions, duly disposed, is of a perfect Form, and most proper to persuade. An Imperfect *Argumentation* is, either an *Enthymeme*, an *Induction*, an *Example*, a *Dilemma*, or a *Sorites*, whose Form is less accurate, and not so accommodate to persuade as the Perfect. We shall first treat of a *Syllogism*, and afterwards proceed to the rest.

XVI.
The Division
of an
Argumentation
into
Perfect and
Imperfect.

CHAP. XVI.

Of Simple Syllogisms; and those either Complex, or Incomplex.

OF SYLLOGISMS, some are Simple; others are Conjunct. Simple *Syllogisms* are such, in which the Medium is only joyned to one Term of the Conclusion at once: Conjunct are those in which the Medium is at once joyned with both Extreams. Accordingly this *Syllogism*:

*Every Planet is enlightened by the Sun:
Saturn is a Planet:
Therefore Saturn is enlightened by the Sun.*

Is Simple, because the Medium, viz. Planet is separately joyned with the Term Saturn, which is the Subject of the Conclusion. But for the contrary Reason this *Syllogism*:

*If a Covetous man serves Mammon, he cannot obey the Law of God;
But a Covetous man serves Mammon:
Therefore a Covetous man cannot obey the Law of God.*

Is Conjunct, because a Covetous man, which is the Subject of the Conclusion, and cannot obey the Law of God, which is the Predicat, are both joyned with the Medium, serves Mammon, in the Major Proposition. Of this latter sort we shall speak in the next Chapter.

A Simple *Syllogism* is divided into two other kinds: For there are some, in which tho' the Conclusion be Complex, that is, composed of Complex Terms; yet one part only of its Subject or Predicat is taken, to be joyned with the Medium in one Proposition; and the rest, which is no more than one Term, is taken and joyned in the other Proposition: As in this *Syllogism*:

II.
There are
two sorts
of Simple
Syllogisms.

The

*The Divine Law requires us, to honour Kings;
Charles the Second is a King:*

*Therefore the Divine Law requires us to honour
Charles the Second.*

There be others again, in which each whole Term of the Conclusion is joyned with the Medium; to wit, the Attribute in the Major, and the Subject in the Minor. The former are called *Complex*, the latter *Incomplex*: And of these two kinds of *Simple Syllogisms*, we shall speak under this Head.

III.
The Definition of a Simple Syllogism.

A *Simple Syllogism* therefore is a *Perfect Argumentation*, in which from two Propositions premised in the Antecedent, the Conclusion or Consequent necessarily follows, in case the two foregoing Propositions have been granted. I have said in the Definition, *That the Conclusion necessarily follows from the Premisses*; because our assent to the *Premisses* necessitates the *Conclusion*, not only as to *Species*, as they call it, but as to *Exercise*. For the Knowing Faculty acts necessarily, that is, supposing all Requisites necessary for Operation, cannot chuse but operate: But when the *Major* and *Minor* are granted, there is nothing more wanting to infer the *Conclusion*; therefore the Understanding cannot but infer it.

IV.
The Understanding cannot but assent to a Proposition that is clear and evident.

Neither is it any obstacle to what hath been said, that the *Understanding* is subject to the *Will*: For this is false, whenever the Object is evidently and distinctly propounded to it; because in that case it is forced to assent by the Evidence of of the thing. For we often experience in our selves, that the *Understanding* cannot be restrained from giving its Assent to a *Proposition* which appears clear and manifest to it; tho' the *Will* may sometimes indirectly hinder it, by diverting it, and busying it about other Objects: But this it cannot do directly, by commanding it not to assent to the *Conclusion*; because the *Understanding* doth not follow the command of the *Will* in things that are Evident, but only in those that are obscure and doubtful.

V.
The Form of a Syllogism.

The Form of a *Syllogism*, is the Regular disposition of the three *Propositions*, so that the *Conclusion* may necessarily follow from the *Premisses*; which consists in this, that the Middle Term be fitly ranked with the two Extreams, that is, with the *Major* and *Minor*; and also that the *Propositions* be orderly placed, as to *Quantity*, that is, *Universality* and *Singularity*; and *Quality*, that is *Affirmation* and *Negation*. The former of these, which is the Disposition of the Terms, is called *Figure*; the latter, which is the Determination of the Propositions, is called the *Mode of a Syllogism*. So that the *Figure* respects the remote Matter of a *Syllogism*, viz. the Three Terms, the Middle Term, and both Extreams; whereas the *Modus* regards the next Matter of a *Syllogism*, viz. the Three Propositions, the Major, Minor, and Conclusion.

VI.
The three Figures of Syllogisms.

There be three Figures of *Syllogisms*: The First is, when the Middle Term is the Subject in the Major, and the Prædicat in the Minor. The Second, when the Middle Term is the Prædicat in both Premisses. The Third is, when the Middle Term is the Subject in them both.

VII.
Of the Modes of Syllogisms.

There are reckoned 21 Modes of *Syllogisms* which may be reduced to 14.

The Modes of the First Figure, are *Barbara Celarent, Darii, Ferio*.

Of the Second, *Cesare, Camestres, Festino, Baroco*.

Of the Third; *Darapti, Felapton, Disamis, Datissi, Bocardo, Ferison*.

The Modes of the first Figure are called *Direct* and *Perfect*, because all manner of *Questions*, whether Affirmative or Negative, Universal or Particular, may be concluded by it. Whereas in the Second, Negatives only; and in the Third, Particulars only can be infer'd. In all the foregoing Artificial Words there are Three Syllables, whereof the first signifies the *Major*, the second the *Minor*, and the third the *Conclusion*; and the Vowel of each Syllable shews what *Quantity* and *Quality* the Proposition must be of. For *A* signifies an Universal affirming; *E*, an Universal denying; *I*, a Particular affirming; and *O*, a Particular denying Proposition, according to the common Distick.

*Afferit A, negat E, verum Generaliter ambo:
Afferit I, negat O, sed Particulariter ambo.*

*A affirms, E denies, but Generally both:
I affirms, O denies, but Specially both.*

For the further clearing of the Figures of *Syllogisms*, I shall add Examples of the Modes of each Figure.

The First Figure.

Bar- Every Body is extended,
ba- Every Stone is a Body;
ra- Therefore every Stone is extended.
Ce- No Mode is a Substance,
la- Every Figure is a Mode;
rent- Therefore No Figure is a Substance.
Da- Every thing that is mov'd, is mov'd by
ri- Some Body is mov'd; (another.
i- Therefore some Body is mov'd by another.
Fe- No Spirit is Material,
ri- Some Substance is a Spirit;
o- Therefore some Substance is not Material.

VIII.
The first Figure.

The force of the first Figure is grounded on the *Dictum de Omni*, and *Dictum de Nullo*. The *Dictum de Omni* is this: Whatsoever is Universally affirmed of an Universal, is also affirmed of that which is contained under that Universal: As of a *Body*, it is universally affirmed that it is *Extended*; which must therefore also be affirmed of a *Stone*, which is contained under it. *Dictum de Nullo* is, when whatsoever is universally deny'd of an Universal, is also deny'd of that that which is comprehended under that Universal: As when every *Substance* is deny'd to be a *Mode*, and *Figure* is contain'd under the Notion of a *Mode*; therefore *Figure* is denied to be a *Substance*.

IX.
On what Principles the first Figure is grounded.

Ce- No Stone is a Plant,
fa- Every Oak is a Plant;
re- Therefore no Oak is a Stone.

X.
The second Figure.

Ca- Every Body is divisible,
me- No Point is divisible;
stres- Therefore no Point is a Body.

Fe- No Impenitent person shall be saved,
sti- Some man shall be saved;
no- Therefore some man is not an Impenitent person.

Every

XI.
The third
Figure.

- Ba- Every Universal is communicable to more
than one;
ro- Some Nature is not communicable to more
than one;
co- Therefore some Nature is not Universal.

The Third Figure.

- Dar- Every Body is divisible,
ap- Every Body is a Substance;
ti- Therefore some Substance is divisible.
Fel- No Angel is circumscrib'd by place,
ap- Every Angel is Finite;
ton- Therefore something that is finite, is not
circumscrib'd by Place.
Di- Some Number may be increased,
fa- Every Number is an Affection of things;
mis- Therefore some Affection of things may be
increased.
Da- Every one that serves God is a King,
ti- Some one that serves God is poor;
fi- Therefore some one that is poor, is a King.
Bo- Some Folly is not to be blamed,
car- Every Folly is a defect of right Reason;
do- Therefore some defect of right Reason is
not to be blamed.
Fe- No heavy Body tends downward of its
own accord.
ri- Some heavy Body is Matter;
son- Therefore some Matter doth not tend down-
ward of its own accord.

XII.
Galens
Fourth Fi-
gure.

The Fourth Figure is said to be Galen's, and is when the Medium is predicated in the Major Proposition, and subjected in the Minor; which tho' it concludes necessarily, yet (as Averrhoes saith) with some Machination or difficulty, and besides Expectation.

General Rules of Syllogisms.

XIII.
The Rules
of Syllo-
gisms.

Forasmuch as all Conclusions cannot be deduced from any Premisses: There are some Common Rules, which are to be observed in all Syllogisms.

XIV.
The First.

The First is this, *The Middle Term must be distributed, that is, it cannot be twice taken particularly, but must once at least be taken generally.*

For should the Medium be twice taken particularly, as it must be when the Premisses are particular, it may be taken for divers parts of the same Whole; because Particulars are distinct, and so nothing will be concluded, or at least nothing necessarily concluded. Which is sufficient to make an Argumentation faulty, since that only is called a good Syllogism, whose Conclusion, if the Premisses be true, cannot be false. And therefore this Argument,

Some Body is Triangular,
Some Body is Spherical;
Therefore some Spherical Body is Triangular.

For since Body is taken here for divers parts of Bodies, a Spherical cannot be joyned with a Triangular; because the same Body which is Spherical, cannot also be Triangular.

XV.
The Second
Rule.

The Second, *From pure Negatives nothing can be concluded.* The Reason is, because two Negative Propositions separate the Subject from the Medium, and the Attribute also: Now from the separation of two things from the same Thing, it doth not follow, that they are the same Thing, or that they are not the same Thing. As for Example,

from these Propositions that the Mind, is not the Body, and that the Body is not capable of Perception, it doth not follow, that the Mind is not capable of Perception.

The Third, *The extremities of the Conclusion, must not be more Universally taken, than they were taken in the Premisses.*

XVI.
The Third.

Wherefore when either of the Extremities is taken Universally, the Argumentation must needs be false, if it be taken particularly in the two first Propositions. The Reason of this Rule is deducible from the first, because it is irregular to Argue from a Particular, to an Universal. For from this, that some Men are given to Drink Wine, it cannot be concluded, that all Men are given to Drink Wine.

The Fourth, *The Conclusion always follows the weaker part of the Premisses. That is, if either of the Premisses be Negative, the Conclusion must be so also; and if either of the Premisses be Particular, the Conclusion must be Particular also.*

XVII.
The Fourth.

The Reason of this Rule is, because where there is a Negative Proposition in Syllogism, the Medium is removed from one of the extremities of the Conclusion, and therefore can never joyn them together, which is required to make an Affirmative Conclusion; and if either of the Propositions be particular, no Universal Conclusion can be deduced from them. For if the Universal Conclusion be Affirmative, the Middle Term being Universal, must also in the Assumption or Minor Proposition be Universal, and therefore must be its Subject, since the Attribute, in Affirmative Propositions, is never taken Universally; wherefore the Medium joyned to the Subject, will be particular in the Minor; and so the Universal will be in the Major; for otherwise it would be twice particular: And therefore it will be the Subject, and therefore that Major, must be likewise Universal. So that there can be no particular Proposition in an Affirmative Argumentation, whose Conclusion is Universal.

Of Complex Syllogisms.

From what hath been said, may easily be understood what Complex Syllogisms are: For they are not so called, because they consist of Compound Propositions, but because the Terms of their Conclusions are Complex, and are not taken entire in each of the Premisses, in order to their being united with the Medium, but only one part of their Terms: As in this Example.

XVIII.
What Com-
plex Syllo-
gisms are.

Gold is an Inanimate Thing,
Covetous Men worship Gold;
Therefore Covetous Men worship an Inanimate Thing.

In which Syllogism the Attribute of the Conclusion is, *Worship an Inanimate Thing*, whereof only some part is put in the Major, viz. an Inanimate Thing, and Worship in the Minor.

These Syllogisms in the Conversation and Discourses of Men, are more frequent than Incomplex ones, which are seldom or never used, except it be in the Schools? For who ever in common Speech, heard a Man Discourse at this rate: *Every Stone is a Body, A Diamond is a Stone; therefore a Diamond is a Body.* And tho' Complex Syllogisms seem at the first sight, to deviate from the Rules of Figures, yet they appear to be true, when they are reduced to Incomplex ones. For this Syllogism, *The Scripture Commands us to Honour Kings.*

XIX.
Complex
Syllogisms
are to be
reduced.

Charles

*Charles the Second is a King;
Therefore the Scripture Commands us to Honour
Charles the Second.*

Tho' it be in the *Second Figure*, in which it is repugnant for all the *Propositions* to be *Affirmative*, yet it is for all that a true *Syllogism*, because in this *Proposition*, *The Scripture Commands us to Honour Kings*; the word *Kings*, is taken for all *Kings* in particular, and therefore *Charles the Second* is reckoned amongst them, that are to be *Honour'd*. Besides *King*, which is the *Middle Term*, is not the *Attribute* in this *Enuntiation*; the *Scripture Commands us to Honour Kings*, tho' it be united to the *Attribute Commands*. For that which truly is the *Attribute*, is affirmed and agrees: But *King* is neither affirmed, nor agrees, that is, it is not here annexed to *Scripture*, which is the *Subject*. Again, the *Attribute* is restrain'd by the *Subject*, but the term *King*, is not restrain'd in this *Proposition*; *The Scripture Commands us to Honour Kings*, because it is taken *Universally*. Wherefore we must say, that it is the *Subject* of another *Proposition* involved in it, as if I should say, *The Scripture Commands that Kings be Honoured*. So that this whole *Argument* consists in these *Propositions*,

*Kings are to be Honoured,
Charles the Second is a King;
Therefore Charles the Second is to be Honoured.*

And therefore this *Proposition*, *The Scripture Commands*, which before was look'd upon as *Principal*, is only incident to this *Argumentation*, and is joyned to the *Affirmation*, to which the *Scripture* is added as a *Proof*. Whence it is manifest, that this *Argument* is of the *first Figure*, and in *Barbara*, because that *Singulars* are esteemed *Universals*, when they are made use of in their whole *Latitude*.

CHAP. XVII.

Of conjoynd or Compound Syllogisms.

I.
What is required to make a Compound Syllogism.

Conjoynd or Compound Syllogisms are those in which the *Major* is so compounded, that it contains the whole *Conclusion*. And because the *Major Proposition* of such Syllogisms is four-fold, viz. *Conditional*, *Copulative*, *Disjunctive* and *Proportional* or *Analogical*, therefore they constitute four kind of Syllogisms, *Conditional*, *Copulative*, *Disjunctive*, and *Analogical*.

II.
Conditional Syllogisms.

Conditional Syllogisms are those in which the *Major Proposition* is *Conditional*, and contains the whole *Conclusion*, As

*If the Soul of Man be Corporeal, it may be divided into Parts,
But the Soul of Man cannot be divided into Parts,
Therefore it is not Corporeal.*

The *Major* consists of two *Propositions*; the first is the *Antecedent*, *If the Mind of Man be Corporeal*; the second, the *Consequent*, it may be divided into *Parts*:

III.
The twofold Figure of Conditionals.

The *Figure* of *Conditionals* may be two-fold; the first is, when the *Antecedent* of the *Major*, or *Principal Proposition*, is put in the *Minor* or less *Principal*, so as that the *Consequent* of the same may be put into the *Conclusion*; as in this Syllogism:

If created things cannot subsist of themselves, it is necessary that they be preserved by God,

*But created things, cannot subsist of themselves,
Therefore it is necessary that they be preserved by God.*

And this sort of *Argument* is founded upon this *Maxim*; where the *Antecedent* is put the *Consequent* must be put also.

The other *Figure* is when the *Consequence* of the said *Major Proposition*, is taken away, that the *Antecedent* may be taken away also; As,

*If John doth Marry this Woman, he is unwise,
But John is not unwise,
Therefore John doth not Marry this Woman.*

This kind of *Argumentation* is founded on this *Maxim*; Where the *Consequent* is taken away, the *Antecedent* must be taken away likewise. Now to put the *Antecedent* or *Consequent*, is to *Affirm* that which is *Affirm'd*, and to *Deny* that which is *Denied*: And to take them away, is to *Deny* that which is *Affirm'd*, or *Affirm* that which is *Denied*. Or to speak more distinctly, to put, is to *Affirm* the *Antecedent* that hath been *Affirm'd*, or to *Deny* the *Antecedent* that hath been *Denied*; and on the contrary to remove, or take away, is to *Deny* the *Affirm'd Consequent*, or to *Affirm* the *Denied Consequent*. So that he also takes away that *Affirms*, that which was *Denied* before. As for Example, *If an Angel hath not Organs, he doth not Feel: But he hath not Organs, Therefore he doth not Feel*, Is a Syllogism deduced from the *Position* of the *Antecedent*, to the *Position* of the *Consequent*, notwithstanding that it proceed by way of *Negation*.

Conditional Arguments become faulty, these two manner of ways; the one is when from a true *Major*, a false *Conclusion* is deduced: As when the *Antecedent* is inferred from the *Consequent*: As if one should say,

*If a Stone be a Living thing, it is a Substance,
But a Stone is a Substance,
Therefore it is a Living thing.*

And another way, when from the *Negation* of the *Antecedent*, is inferred, the *Negation* of the *Consequent*; As in the same Example,

*If a Stone be a Living thing, it is a Substance,
But a Stone is not a Living thing,
Therefore it is not a Substance.*

Copulative Syllogisms are only of one sort, as when in a *Copulative Proposition* *Negative*, one part is put, to take away, or remove the other As,

*The same Body cannot be at the same time, both Round and Plain;
But the Earth is Round,
Therefore it is not Plain.*

Because these Syllogisms do not necessarily conclude, when one part is taken away, and the other is put in its place; as appears in this *Argument*, taken from the same *Proposition*.

*The same Body cannot be both Plain and Round,
But the Earth is not Round,
Therefore it is Plain.*

Disjunctive Syllogisms are such whose first *Proposition* is *Disjunctive*, that is, whose *Parts* are joyned with the *Disjunctive*, or, either.

Death happens to Man either by default of the Soul, or of the Body;

IV.
The Maxim of the first sort of Conditional Syllogisms.

V.
The Maxim of the other sort of Conditional Syllogisms.

VI.
Conditional Arguments may be faulty two manner of ways.

VII.
What Copulative Syllogisms are.

VIII.
What Disjunctive Syllogisms are.

But

IX.
Their Fi-
gure is
twofold.

But it doth not happen by default of the Soul,
Therefore by default of the Body.

The Figure of Disjunctive Syllogisms is two-
fold; the one, when one part is taken away, that
the other may be put; as in the Example before
alledg'd: The other, when one part is put, that the
other may be taken away: As,

*They who first gave us an account of Antipodes,
either spoke the Truth, or imposed upon us;
But they spoke the Truth,
Therefore they did not impose upon us.*

A Disjunctive Syllogism is grounded on this Prin-
ciple, that two Contradictions cannot be true at the
same time. Wherefore it is necessary, that the
Parts of a Disjunctive Proposition must be Repug-
nant, so as that when one is put, the other is remov'd;
and when one is remov'd, the other is put, as in the
alledged Examples. When it happens, that there
be more Parts of the Disjunction than two, one of
them must be opposed to all the rest; as if one
should make this Proposition:

*It is either Winter, or Summer, or Spring, or
Autumn,*

One part only must be put in the Assumption or Mi-
nor Proposition; that so in the Conclusion, the rest
may be taken away; As thus,

*It is Winter, therefore it is neither Summer, nor
Spring, nor Autumn,*

Or else the rest must be taken away in the Assump-
tion, that one Member may be put in the Conclu-
sion; thus,

*It is neither Summer, nor Spring, nor Autumn,
therefore it is Winter.*

X.
How Ana-
logical Syl-
logisms are
formed.

To these we may add Proportional or Analogi-
cal Syllogisms, in which the Analogy and Propor-
tion is dilated, or Adjuncts are explained. For Pro-
portions here spoken of is nothing else, than the
agreement of Relatives. As when from four Rela-
tives; as for Example, four Numbers, 2, 4, 3, 6,
we say that the same is the Relation of the half,
and double, between 2 and 4, as between 3 and 6.
Or when in a Triangular Figure, considering the
two Angles of it, and the two opposit Sides; we
assert the Relation of Equality and Inequality to be
the same, as there is between Side and Side. The
First and Third, are by Geometricians commonly
called Antecedents, as the Second and Fourth Con-
sequents, because they follow from the former.

XI.
What Ana-
logical Syl-
logisms are

SYLLOGISMS are called Proportional or
Analogical, when the Proportion set down in the
Major Proposition, is protracted, or dilated: Which
then happens, when the Consequents in the Minor,
being taken for Antecedents, are further referred to
other Consequents: And then conclude, that there
is alike Proportion between the first Antecedents, as
between the latter Consequents. As when we say,
2 are to 4, as 3 are to 6, and 4 are to 8, as 6 to 12.
Therefore 2 are to 8, as 3 to 12. Because in this
way of Discourse, it is made clear, that 4 and 6,
which are the Consequents in the Major Proposi-
tion, are made the Antecedents in the Minor: And
because the Relates are the Middle Terms, to which
the Extreams (viz. the Antecedents and Conse-
quents) are joyned, therefore we infer, that the Ex-
treams themselves, agree also. And such Syllo-
gisms as these, are said to conclude equally; for as
much as in them, both the Relations as they begin

in the same manner, so likewise they proceed and
end, in the same manner.

Analogical Syllogisms are also formed in this
manner, when after that a like Proportion hath
been set down in the Major Proposition, an Adjunct
is taken up in the Minor, by which the Proportion
is rendered more evident, which therefore so agrees
to one Antecedent, with respect to its Consequent,
that thence we conclude, that it also agrees with
another Antecedent, with respect to its Consequent.
For if one should call at Pleasure two Sides of a
Triangle, A, B, and the two opposit Angles, C, D,
and then argue thus: The Side A is to the Side B,
as is the Angle C to the Angle D; but the Angle
C is greater than the Angle D; therefore the Side
A is greater than the Side B. For by this Term
Greater, it is clearly explained wherein the Pro-
portion consists.

Thirdly, Proportional Syllogisms are made by the
Commutation of Proportions; viz. when a Propor-
tion being set down in a like manner in the
Major Proposition, the Minor is past by in Silence,
and the Relates are so inverted, that they are mu-
tually concluded of each other. This way of Ar-
guing is often used by Geometricians, and more
especially by Arithmeticians: As when they reason
thus; There is the same Proportion betwixt 2
and 4, as betwixt 3 and 6, and therefore 4 are
to 2, as 6 are to 3; because that Maxim is impli-
citly understood, that Like things agree with their
Like reciprocally.

XII.
The Second
way of
forming
Proportio-
nal Syllo-
gisms.

XIII.
The Third
way.

CHAP. XVIII.

Of Imperfect Argumentations.

SOME Argumentations are called Imperfect,
not with respect to the Matter whereof they
are composed; but with regard to the Form,
which is not so exact in them, but less digested than
that of a Syllogism. For in these the Antecedent
consists expressly but of One Proposition, or of
Many: Such are Enthymeme, Induction, Example,
Sorites, and Dilemma.

An ENTHYMEME seems to have taken its
Name from this, that it expresseth only One Propo-
sition, and suppresseth the other, as being too clear
and obvious, and which is easily understood by
those we discourse with. This way of Arguing is
very common among Men, who in their usual
Reasoning commonly suppress the Proposition, as
supposing that they to whom they speak will easily
supply it: As when we say,

*I was able to save thee,
And therefore also to ruin thee.*

In which Argumentation there is only one of the
Premisses express'd, and the other suppress'd or
imply'd, which when added it affords this Perfect
Syllogism.

*Whosoever was able to save thee, was also able
to ruin thee;
But I was able to save thee,
Therefore I was also able to ruin thee.*

INDUCTION is an Argumentation, which
from many Singulars concludes an Universal:
As,

*This Triangular consists of three Lines, and so
doth that likewise, and all the rest; therefore every
Triangle consists of three Lines.*

I.
What Im-
perfect
Argument-
ations are.

II.
What an
Enthy-
meme is.

III.
Induction.

To

To this way of Reasoning it is required, that it contain an enumeration of all the *Species and Parts*; for if but one be wanting, it admits of an Exception, and subverts the whole *Proposition*. Wherefore nothing can certainly be proved by *Induction*, except the same be whole and compleat in all its Parts, and so General, as to admit no Exception, which is very difficult, and almost impossible. For who can recollect in his Mind all the Cases of *Law*? or what Student of Natural Philosophy, can reckon up all the several kinds of *Bodies*, all *Plants*, *Animals*, *Stars*, &c.? Are not almost all Men of Opinion, that *Heat* dilates, and *Cold* contracts? Yet when we search more narrowly into the matter, we find that when *Water* is frozen, it takes up more space than when it is not frozen? Wherefore in cases where the greatest part of Particulars is only known, we can infer no more but thus; that *for the most part it is so*: Tho' sometimes we meet with some Special Cases, which swerve from the Common Rule. So from many Experiments we conclude, *Snow to be white*, a *Crow black*, and *Honey sweet*; notwithstanding that in some Countries there be found *red Snow*, *white Crows*, and *bitter Honey*.

IV. *What Example is.* **EXAMPLE** is a kind of *Imperfect Argumentation*, whereby from one *Singular* we gather another, because of a likeness of Reason that is between them. As when from this, *That Cæsar subdued the People of Rome more by his Clemency, than by his Arms*; I gather, that a Prince ought rather to have recourse to *Clemency*, than to *Arms*, for the reducing of his Subjects. Or when considering that others, by serious Meditation have arrived to some degree of Learning; I infer, that I my self also may arrive at the same by closely following my Studies, and by an attentive Consideration of the Things I undertake to examine.

V. *Argument from Authority.* To an *Example* belongs that which is called an *Argument from Authority*; which is, when we make use of the Testimony of one or more, to infer a Conclusion; whose force depends of a concealed, but yet imply'd Proposition: As when a Man saith, *Archimedes, and other famous Mathematicians assert, that the Sun is many times bigger than the Earth*: Therefore we ought to hold the Sun to be many times greater than the Earth. For here this Proposition is understood, *That every man ought to be believed in his own Art and Profession*: Or we are to take that for Truth, which *Archimedes*, and the most Learned *Mathematicians* do assert of their own Art.

VI. *Sorites.* **SORITES**, is an *Argumentation* consisting of many Propositions so disposed, that the *Predicat* of the foregoing Proposition becomes the *Subject* of the following; whence the last *Predicat* is in the Conclusion attributed to the first *Subject*: As in this Example, *Covetous persons desire many things, They who desire many things want many things, They who want many things are miserable; therefore Covetous men are miserable*.

VII. *When a Sorites doth not conclude truly.* This Argument doth not conclude truly, but when whatsoever is said of the *Attribute*, is likewise said of the *Subject*: Wherefore this *Ratiocination*, *Salt-meat excites to drink, and by drinking Thirst is extinguish'd; therefore Salt-meat extinguisheth Thirst*, is faulty: Because *Salt meat* only by Accident invites Men to drink, forasmuch as it eaves a dryness in the Throat, which causeth drinking.

A **DILEMMA** is made by the *Disjunction* of many Propositions opposite to one another, whereby the Answerer is so shut up, that there is no way left for him to avoid the dint of it, which part soever he chooseth: As suppose a Man should accuse another of a Crime he hath committed, thus; *Either you did know your self to have offended against the King, or not; if you did know it, how durst you violate the Law of Majesty? If you did not, why did you run away?*

A *Dilemma* may be faulty two manner of ways: One. when the *Disjunctive Proposition* wherein it is founded doth not contain all the parts of the thing divided: As if a man would prove, *That one ought not to Marry, by this way of Arguing; If you marry a Wife, she will be either Beautiful or Deformed; if Beautiful, she will make you Jealous; if Deformed, you will loath her; therefore you ought not to marry at all*. The Mistake is, because there are *Women* who neither are so Beautiful, as to cause Jealousie; nor so Deformed, as to cause Loathing.

In the Second place, a *Dilemma* is vicious, when the particular Conclusions of either part are not necessary: Thus it doth not follow that a *Beautiful Wife* must needs make her *Husband* Jealous, forasmuch as she may be so Prudent and Chaste, as not to give the least occasion to doubt of her Vertue. Neither is it necessary that a *Deformed Wife* should be displeasing to her *Husband*, because her Deformity may be made up by her Vertue and Ingenuity, which may render her very grateful to her *Husband*.

He that makes use of a *Dilemma*, must take care that it be such as may not be retorted upon himself, which it is said *Protagoras* did; to whom *Euatlus*, his Disciple, having promised a certain Sum of Money in consideration of his instructing of him, to be paid on that Day when he should first get the better in the Cause he pleaded; and taking that for his first Cause, to plead whether he was to pay that Sum of Money he had promised him, made use of this *Dilemma*: *Either I shall lose this Cause, or I shall win it: If I lose the Cause, then according to our Agreement, I am to pay you nothing; if I win it, then I shall owe you nothing by the Sentence of the Judges. Which Argument Protagoras thus retorted; Either you will lose this Cause, or win it: If you lose it, you will by Sentence be obliged to pay me; if you win it, you must pay me according to the Tenour of our Agreement*.

CHAP. XIX.

Of Demonstration, a Topical Syllogism and Sophistical.

FOR the better understanding of the following Discourse of *Apodictical, Topical, and Sophistical Syllogisms*, it is necessary that we first explain the Nature of *Science, Opinion, Error, and Faith*; that by exhibiting their distinct Notions, the Principles from whence they are derived may be the better known.

SCIENCE is the certain and evident knowledge we have of any thing: For whatsoever is so evident to us, that we are certain of it, that we are said to know, or have the *Science* of. Accordingly the knowledge of a Conclusion is certain and evident.

VIII. *What a Dilemma is.*

IX. *A Dilemma may be faulty two manner of ways. The First.*

X. *The Second.*

XI. *What is to be observed in a Dilemma.*

I. *How Science, Opinion, Faith, and Error are distinguished.*

II. *What Science is.*

III.
What Opin-
ion is.

dent, when the *Premisses*, whereon as *Principles* it doth depend, are so.

OPINION, is a Knowledge that is not altogether certain, but joyned with some fear or wavering of the Intellect, in its assent to it. For *Opinion*, tho' it be a true assent to the Conclusion; yet is it doubtful and uncertain; and such an assent as this is the Effect of a *Dialectical Syllogism*, as *Science* is the Effect of a *Demonstrative*, or *Apo-dictical Syllogism*.

IV.
What Error
is.

ERROR is an Opinion opposite to *Truth*, that is, a False one.

V.
What Faith
is.

FAITH is a Persuasion founded upon the Testimony of another, which may be either true or doubtful, according to the different Authority it rests upon. So the *Faith* we have to God is most firm and stable, because we know him to be True, and that to Lye is repugnant to his Nature. But the *Faith* we have to a Man, hath always something of Uncertainty joyned with it; since there is no man but can deceive another, if he please.

VI.
How we
may distin-
guish the
several
kinds of
knowledge.

If in considering any *Axiom*, the truth of it do immediately appear to us, from the Evidence that is found in it, without any further Proof or Disquisition, this kind of Knowledge we call **INTEL-LIGENCE**: And thus we know *first Principles*. But if by its own proper Evidence, it cannot engage the *Understanding* to assent, then we must have recourse to other Motives, by which the Intellect may be convinced of its Truth: Now these Motives can be no other, but *Reason* and *Authority*. If *Authority* engageth us to assent to the things Propounded to us, this is that we call *Faith*: But if *Reason* sways us, then either that *Reason* leaves some fear behind it, whereby we are made doubtful of the certainty of the thing, and then this assent is called *Opinion*: Or the *Reason* doth satisfy fully the *Understanding*, and then it is either *Seemingly* only Evident, for want of due Attention, and thence comes *Error* in case it be really false; or at least a *Rash Judgment*, if we take it to be true, before we have sufficient grounds of giving our Assent to it: Or if the *Reason* proposed to us, be not only seemingly true, but evidently so, and be clearly and distinctly perceived by our *Understanding*, then the Conviction produced in our Mind by this *Reason*, is called *Science*.

Forasmuch therefore as *Demonstration* begets *Science*, and that the Conclusion of a *Demonstration* is *Science*, we will first Treat of it, and afterwards in order, of those things that produce *Opinion* and *Error*.

VII.
What De-
monstration
is.

DEMONSTRATION is a *Syllogism* consisting of *Premisses* that are True, Immediate, Prior, more known and causes of the Conclusion. Those *Propositions* are said to be True and Immediate, which have their Evidence from themselves, and not from any other thing: And which are known by their Terms: As, *Every thing is, or is not*. For there is an Inborn Power or faculty in us, whereby we assent to *first Principles*. Wherefore we should never give our assent to the Conclusion, except the *Premisses* appeared evident to us; neither do we assent to the Conclusion, but because we believe the *Premisses* to be true; and therefore it is necessary that the *Premisses*, be more known than the Conclusion, according to that saying; *That for which any thing is such, is more such it self*.

VIII.
Demonstra-

Demonstration is twofold, the one *a Priori*, and

the other *a Posteriori*. *Demonstration a Priori* (which alone, to speak properly, is *Demonstration*) is that in which the Effect is Demonstrated by its Cause: As when we prove the Existence of *Light*, by the Existence of the *Sun*. Or when *Geometricians* prove that round Wounds are longer a Healing, than such as are of a long Figure, forasmuch as in those, the Sides are further distant than in these.

Demonstration a Posteriori is when we Demonstrate the Cause by the Effect: As when from the Existence of *Light*, we Demonstrate the Existence of the *Sun*. When we prove the *Heaven* to be Fluid and Corruptible, from the various Things that are Generated in it; as from the *Comets* that are found in it; from the *Spots* about the *Sun*, and from many *Stars*, which for some time shew themselves there. To this kind of *Demonstration* may also be reduced the *Demonstration* which is made from the remote Cause, as when one proves that a *Stone* doth not breathe, because it is not an *Animal*, when it would have been more proper to have proved it by this, because it hath no Lungs. For the having of Lungs is the near cause of *Respiration*, and not the being an *Animal*; nay it will be found that to have Lungs is not the property of an *Animal*, since there are many *Animals* that have no Lungs, as *Oysters*, &c.

Antient Authors make mention of another kind of *Demonstration*, which they call *Offensive*, by which a thing is Demonstrated from proper *Principles*, directly and by it self. As if a Man, when a right Line is given, and a *Semidiameter* made of two *Circles*, and two other right Lines, to one of the Intersections of the *Circles*, drawn from their Extrems, and by these three Lines a *Triangle* is made, should prove *Offensively* that this *Triangle* is *Equilateral*, or hath all its Sides alike, by shewing that the two last Lines are even, or of the same Length, because they are equal to the same Line given; and that they are equal to the same Line given, because both of them separately proceed from the same Center, to the same Circumference with it.

To this they have added another kind of *Demonstration*, which they call *Deductive to an inconvenient*; which tho' it be inferior to the former, yet may be of use, where we cannot have an *Offensive Demonstration*, as being also of insuperable necessity. And this is when we demonstrate a thing to be so, because if it should be otherwise, either an Absurdity, or an Impossibility, or a contradiction must necessarily be granted: Such as is, *That the Effect doth not depend on the Cause*; And *that the thing containing is less, than the thing contained*, and the like. As if by Deduction to an inconvenient he would prove the above said *Proposition* from hence, because no Side can be admitted to be equal to another; but at the same time it must be granted, that all Lines drawn from the Center to the Circumference are equal; or that two things which are equal to one thing, are not equal between themselves.

ATOPICAL SYLLOGISM, which is also called *Suasory*, or *Opinable*, is that which concludes from *Probables*: Or whose *Premisses* do not hold forth, a necessary Connexion of the Subject, with the Middle Term, or of the Middle Term with the Attribute. For tho' the Conclusion it proves, partaks more of Evidence than Obscurity, yet it leaves something of doubt or *Hesitation* behind.

tion is two-
fold either
a Priori,
or from the
Cause.

IX.
Demonstra-
tion a Po-
steriori, or
from the
effect.

X.
Of Offen-
sive Demon-
stration.

XI.
Demonstra-
tion by De-
duction to
an incon-
venient.

XII.
What a To-
pical Syllo-
gism is.

hind it, which makes that the understanding cannot assent without some Scruple. And therefore 'tis commonly said that a *Topical Syllogism* doth persuade indeed, but doth not force one to assent as a *Demonstration* doth.

XIII.
What things are called probable.

Those things are called *Probable*, which seem to be so to all, or to the most, or to the Wise, or at least to the most, or most considerable amongst them: As it seems *Probable to all*, that the approaching *Summer* will be *Hot*, yet it is not certain, forasmuch as it sometime happens that the *Summer* is very *Cold*. It appears to most, that *Physick is necessary for the Curing of Diseases*, whereas, notwithstanding it often happens, either through the Ignorance of the *Physician*, or through Default of the *Patient*, the Distemperature of the Air, or the Unhealthfulness of the Place, that a *Medicin* may do more hurt than good. It appears to *Wise Men*, that *Learning* ought to be desired by all; when notwithstanding there be many found that despise it, and who prefer their *Ignorance* before *Learning*. The most considerable Men, are of Opinion that the *Earth* is moved, and that the *Sun* stands still in the midst, and yet there are many that oppose this Opinion, and maintain the contrary.

XIV.
How a Topical Syllogism is distinguished from all others.

Wherefore all those *Syllogisms*, whose *Premises* are *Contingent*, and do not infer a necessary Connexion between the *Subject*, and the *Middle Term*; or between the *Middle Term*, and the *Predicate*, are called *Topical*, that is, *Local* or *Probable*. The former from the *Places* whence their *Proofs* are taken, the latter from the likelihood of them.

XV.
What a Sophistical Syllogism is.

A *SOPHISTICAL* or *Paralogistical Syllogism*, which with one Word is called a *Sophism*, is a *Syllogism* consisting of false *Propositions*, which yet have an appearance of *Truth*: Or is a *Syllogism*, that begets Error. As for Example, this *Syllogism*,

All Lines drawn from one Point to another are Equal;
But a Right and a Crooked Line, may be drawn from the same Point, to the same Point;
Therefore a Right and a Crooked Line are Equal.

XVI.
Of the various ways of deception in Sophistical Syllogisms; and first of the Fallacy in Words.

All *Fallacy* or *Deception*, is either in the very Form of the *Argument*, or in the Words, or in the Things. As to the Form of *Argumentation*, we have already largely Treated, in Chapter XVI. As for the Cavilling which consists in Words, that is called *Fallacia Dictionis*, or *Fallacy in Words*, which frequently consist in the Homonymy of the Words, when things altogether different are signified with the same Word. Sometimes also in the Ambiguous context of the Speech, and then it is called *Amphibology*; Examples of which kind, do also occur amongst the best of Authors.

XVII.
The Fallacy from a conjoyned Sense to a divided, and on the contrary.

There is another *Sophistical* way of Arguing, from conjoyned Things, to those that are divided; and on the other Hand, from Things divided to those that are conjoyned. This hath given occasion, to that Distinction of a Divided and a Compound Sense. The former is, when a *Faculty* or *Power* is joyned with an opposite Act; as the *Faculty* of *Laughing*, with the Act of *Weeping*; for this Proposition, he that *Weeps* can *Laugh*, is true in a Divided, though not in a Compound Sense. But a Compound Sense is, when two opposite Acts are

united together; and thus, this Proposition, *He that Laughs cannot Weep*, is true in a Compound, Though not in a Divided Sense.

There is a Third way of Cavilling, when we Argue from Second intentions, to First; as thus; *A Circle is a Figure; But Figure is a Genus, therefore a Circle is a Genus*.

The Fourth is a *Dicto secundum quid*, from a Relative Expression, ad *Dictum simpliciter*, to an absolute Expression; As if a Man should Argue, that because *Blackamoors* are *White*, with respect to their *Teeth*, therefore they are absolutely *White*; or because *Wine* is for the most part Hurtful to Sick Persons, should conclude *Wine* to be absolutely Hurtful.

The Fifth is that which is called *Ignoratio Elenchi*, or Ignorance of the matter in Question, which is, when another thing is proved, than that which is denied by the Adversary.

The Sixth is *Petition of the Principle*, when the Point indispute is taken for granted. As if one should go about to prove that the *Earth* doth rest, because the *Sun* is moved: that being the *Principal* thing in Question, whether the *Sun* be moved.

The Seventh is taken a *Non Causa ad Causam*, from a No Cause to the Cause, as when that is brought in for a Cause, which is no Cause at all: As when we refer the changes of times to the Moon.

The Eighth way of Cavilling, proceeds from a manifold Question, which is, when many Questions are so Propounded, that they look like one only. As if one should ask, whether the *Sun* and *Earth* are moved.

There is no safer way to avoid these Captious *Sophisms*, than to define the Words themselves, in case of a *Fallacy* from *Equivocation*, or *Homonymy*. Neither are we only diligently to consider, what the thing in Question is, but also, what is the *Attribute* of the Question, and what Relation and Order it hath to the *Subject* it self. For it is of great importance, whether the *Attribute* be Universally by it self, and primarily *Attributed* to every *Subject*, or that it agree to some one only, or by *Accident*. In like manner, whether the *Attribute* be spoken of the *Subject* simply, that is, absolutely, or with respect to something: All which particulars may be easily known, from what hath been already said.

The Places from whence the Middle Term is Fetch'd.

We come now to the General Heads, or as the Rhetoricians call them, *Places of Arguments*, to which the *Proofs* which we use in any matter, may be reduced. For as some *Syllogisms* are *Demonstrative*, others *Opinable* or *Opinionative* and *Susory*, and others again *Paralogistical* or *Erroneous*, so there must be divers Places, whence the *Middle Term* or *Argument* may be Fetch'd.

For in a *Demonstrative Syllogism*, the *Middle Term* agrees with the *Subject*, and the *Attribute* with the *Middle Term*, as a *Genus*, or a *Propriety*, or a *Definition*, or a Cause acting necessarily, and the like. As if a Man should have a Mind to Demonstrate that a *Mote* in the *Sun*, is indefinitely divisible, he may take the *Genus* for his *Middle Term*, and argue thus: A *Mote* is a *Body*, but a *Body* is indefinitely divisible, therefore a *Mote* is indefinitely

XVIII.
The Fallacy from the second Intention to the first.

XIX.
From a Relative to an absolute Expression.

XX.
Ignorance of the matter in Question.

XXI.
Petition of the Principle.

XXII.
From a No Cause to a Cause.

XXIII.
From a manifold Question.

XXIV.
The manner how to avoid Sophisms.

XXV.
What the Places are from which the Middle Term is fetch'd.

XXVI.
The Middle Term in a Demonstrative Syllogism, may be the Genus.

XXVII.
Or a Propriety.

finitely divisible: The Minor is to be suppos'd from *Natural Philosophy*.

So to demonstrate a Mans being *Rational*, we may take his Property, which is the Faculty of Speaking, and Reason thus: The *Power of Speaking*, that is, the Faculty of expressing ones Mind by Words, Signs, or Gestures, *belongs to Man*; But *whatsoever enjoys this Faculty doth partake of Reason*; therefore Man doth partake of Reason.

XXVIII.
Or a Definition.

So likewise a *Definition* may serve for a Middle Term, to prove that *Oysters* are *Animals*, thus: *Oysters are Bodily things, endued with life and motion*: But *whatsoever hath life and motion is an Animal*; therefore *Oysters are Animals*.

XXIX.
Or a Cause.

And so also a *Cause* acting necessarily, may be the Middle Term; for thus a *Lunar Eclipse* may be proved from its Efficient Cause, *viz. the Sun and Moon* being placed in opposite *Nodes*, or in the Intersections of their *Orbs*, after this manner: It is necessary for the *Moon* to be Eclipsed, as often as the *Globe of the Earth* interposeth between the *Moon* and the *Sun*, from which the *Moon* borrows her *Light*; but then the *Globe of the Earth* interposeth between the *Moon* and the *Sun*, when the *Sun* and *Moon* are in opposite *Nodes*; (because at that time they are Diametrically opposite, and the *Earth* plac'd in their Diameter) therefore there must necessarily be an Eclipse of the *Moon*, when the *Sun* and *Moon* are constituted in their *Nodes*, or the opposite intersection of their *Orbs*.

XXX.
The Middle Term in a probable Syllogism, may be fetch'd first from the Genus.

We make use also of like places in a *Probable* or *Suasive Syllogism*; yet so as that tho' the *Middle Term* agree to the Subject, (yet the *Attribute* does not to the Middle Term, as a *Genus*, *Propriety*, &c. as before :) As if a Man to prove *Rhetorick* to be profitable for Mankind, should argue thus; *Rhetorick is an Art, but every Art is profitable to Mankind*; therefore *Rhetorick is profitable to Mankind*. In which *Syllogism*, the Middle Term *Art*, is indeed the Genus of the Subject *Rhetorick*; but the *Attribute is profitable*, is not its Genus, but only a contingent Adjunct, or common Quality; and therefore neither doth the Mind assent to it without something of Doubtfulness, whether or no *Rhetorick* may not be reckon'd amongst those Arts, which tho' they be accounted Subtil, yet are esteem'd by some as unprofitable, or at least indifferent.

XXXI.
From a Propriety.

In like manner one may prove, from a *Propriety* of *Logick*, that *Logick* is a thing desirable, thus: *It is the Property of Logick, to direct the Mind in the knowledge of things*; but *what directs the Mind in the Knowledge of things, is something desirable*; therefore *Logick is a thing desirable*. This Argument also leaves some hesitation in the Mind, because the directing of the Mind in the Knowledge of Things, doth not necessarily conclude the thing to be desirable; because there are many who rather desire to continue in their Ignorance, than to be instructed in *Logick*.

XXXII.
From the Cause.

We may also argue from the *Cause* thus: *This Picture is drawn by Apelles*; but *the Pictures drawn by Apelles are very exact*: Therefore *this is an exact Picture*. Which enforceth only a Probable, but not a certain Conclusion; because the best *Painters* do not always Paint alike, nor so exactly, but that sometimes Faults may be spied in their Works.

A *Paralogistical*, or *Sophistical Syllogism*, has but one only place, *viz. Ambiguity*; which being once detected, its Imposition lies open; and that which seem'd to be a good *Syllogism* appears to be none at all. Because the Reason of *Syllogism* requires, that it have only one Middle Term, one Subject, and one Attribute; whereas in a *Sophistical Syllogism* there are two Subjects, and as many Attributes without a Middle Term: As when a man Argues, *some Mountain is Taurus, Taurus is a Lowing Animal*: Therefore *some Mountain is a Lowing Animal*. For the Ambiguity here lies in the word *Taurus*, which agreeing to two different things, is in the Major taken for a *Mountain*, and in the Minor for a *Four-footed Animal*. Whence it appears, that the word *Taurus* is no Middle Term, forasmuch as it doth not agree with the Subject and Predicate.

XXXIII.
Ambiguity is the only place for a Sophistical Syllogism.

For *Ambiguity* is that which occasions deception in all things; for he that concludes, that a Man *asleep is awake*, because it hath been before granted, that it is possible for a man that sleeps to be awake, doth not do it for any other Reason, but because this Proposition may be understood either disjointedly, with respect to different times; or conjunctly, with regard to the same time. And he who concludes that the *Buyer hath eaten raw flesh*, because it may be, he confess'd that he had eaten what he had bought, doth so because of the Ambiguity of the words, *What he had bought*; which may either be taken only for the substance of the *Flesh*; or also for an Accident of it, *viz. Rawness*. And the like may be said of all *Sophistical Places*, *Amphibology*, *Composition*, *Division*, *Account*, &c. forasmuch as they all agree in this, that they have some *Ambiguity* either in a *Word*, or in a *Phrase*; or that one Sense is taken in the Proposition, and another in the Assumption. So that it is no wonder, that when both are admitted for True, an Absurdity follows from them.

XXXIV.
Ambiguity is the cause of Deception in all things.

The Fourth Part of Logick.

Concerning Method, or the Orderly Disposition of our Thoughts.

CHAP. XX.

Of the General Method of Knowing.

Forasmuch as LOGICK was found out for the attaining of Sciences, and that our Thoughts can hardly be rightly formed without its assistance, METHOD seems to be necessary to assist and accomplish our Mind in the Knowledge of Things. For tho' possibly there may be some of such quick and piercing Wits, as without difficulty to dive into the Natures of Things, and to solve the most abstruse Questions; yet will he never be able to attain certain Knowledge, except he be first acquainted how he must direct his Mind, and what Order he must observe. Wherefore Method is necessary, as well to assist him in the searching out of Truth, as in the avoiding of Error, Confusion, and Obscurity. Which Method is nothing else, but an Orderly disposition of things to be treated of, suitable and accommodate to the Capacity of Learners. For it must

I.
Method is necessary to the Right forming of our Thoughts.

must be of that Nature, as not to put any force upon the *Wit* of Man, but rather pleasantly allure it, and guide and direct it by the Evidence and Easiness of its *Rules* and *Precepts*.

II.
Three things are requisite to the manner of Knowing.

This Mode or manner of *Knowing* consists in Three things: *First*, That the thing propounded may be clearly and distinctly Perceived. *Secondly*, That we judge rightly concerning the Matters we have thus clearly and distinctly perceived. *Thirdly*, That we commit to Memory the *Truths* we have discover'd, that is, the things we have rightly Perceived and Judged. By observing these Three *Precepts*, we shall relieve all the Weaknesses of our Mind, and prevent those *Errors* into which it is apt to fall. For seeing that the main Obstacles of *Science* are, either an *over-hastiness* of the Mind; the same will be removed by clear and distinct Perception; or else *Error* and *Doubt*, which will be cured by Sound Judgment; or lastly, *Forgetfulness*, which will be prevented by the Remembrance of the Things perceived and judg'd by us. It remains only to enquire, by what means this *distinct Knowledge* may be attained; and how our Mind may be brought to that pass, as never to assent to any thing which it has not before clearly perceived, and so to impress the Things she has judg'd of in her Memory, that she may never forget them.

III.
First, the distinct Perception of the thing.

As to the *First*, it is requisite, that setting aside all *Precipitancy*, we give heed to the Matter propounded, and (as it were) scan the same with our inward Eyes. In order to which, it will be proper for us to behold or contemplate one thing only at once, that our Understanding may not be distracted by the multitude of *Objects*, and left by minding many things, our attention to Particulars may be the less. For the multiplicity of *Objects* presented to our Understanding, breeds Confusion; and as they who behold a Field, distinguish'd with variety of *Colours*, do not distinctly perceive the variety of *Colours* that is in it, but behold it under the appearance of one Colour only: So they who consider several *Objects* at once, cannot bestow a due attention upon every particular; and it cannot otherwise be, but that they must be promiscuously confounded in their Mind.

IV.
Wherefore we must rather set our selves to examine Simple things, than those that are Compound.

In order to attain this due *Attention*, it will be of good use to undertake the examining of a *Simple thing*, or of some *Attribute* or *Mode*: For these kind of Perceptions, whereby Simple and Incomplex things are represented to us, are more clear and distinct. As for Example, The *Soul* of Man is more distinctly perceived by us than *Man*; because the *Soul* of Man imports one Nature only, viz. a *Thinking Being*; whereas a *Man* comprehends two Natures, viz. a *Soul* and *Body*, which belong to two different *Genera*, and therefore cannot be both at once proposed to the *Intellect* without some confusion.

V.
Things Simple are to be examin'd before those that are Compound.

Accordingly *Simple things* are to be known before *Compound*, near before remote, and few before many. Thus we attain a fuller knowledge of the things that are born, if we begin the consideration of them from their first beginning. By which means the Famous *Harvey* perspicuously discovers the *generation* and *growth* of a *Chicken*, by shewing what Parts are daily formed in an *Egg*, which an *Hen* hatcheth. In like manner we arrive to a more accurate knowledge of a *Plant*, when we take a view of its *beginning*, *progress*, and per-

fection, considering it in its distinct Stages of its *budding*, *growth*, *blooming*, and *bringing forth fruit*; and the same may be said of all things that grow and increase.

But forasmuch as *Substances* are chiefly known by their *Attributes*, and that many of them are found in every *Substance*, we are rather to consider those that are *Positive*, than the *Negative*. Thus the Nature of the *Soul* is more easily known by me, when I consider it as an *understanding*, *willing*, and *judging Subject*, than when I conceive it as *Immaterial*, *Incorporeal*, *Invisible*, &c. because *Negative Attributes* do not so much declare *what a thing is*, as *what it is not*. Wherefore it will also much conduce to the attaining of *Knowledge*, if we always begin our Enquiries with those things that are more Universal, and from them to proceed to Singulars: Because the *knowledge* of *Universals* doth more accomplish our Minds, than that of *Singulars*; the reason whereof is, because *Universals* are in a manner *Eternal*, as having no Original, and not being comprehended within any difference of Time or Space of *Place*, which has given occasion to that noted Axiom of Philosophers, that *Science consists in Universals, and not in Singulars*.

VI.
Things Positive are more distinctly conceived, than Negative.

We shall the better understand all these Particulars that refer to clear and distinct Perception, by firmly retaining in our Memory, what hath been already handled in the First Part of *Logick*; because this Fourth Part is founded upon those *Rules* which are there delivered, concerning the Genealogy of things, their *Causes* and *Effects*, *Subjects* and *Adjuncts*, *Agreement* and *Disagreement* of things, &c.

VII.
We must call to Mind, what hath been said in the First Part of this Discourse.

The Second Precept about the Mode of *Knowing* is this, That our *Judgment* do always follow our *Conceptions*; that is, that we never assent to any thing which we have not before clearly and distinctly perceived: For the Order of *Reason* requires, that *Knowledge* always go before *Judgment*, and that *Simple Terms* make way for those that are *Complex*; but yet so, as that the *Judgment* we pass of any thing, may exactly answer to the *Knowledge* we have of it; as I have before hinted in the *Fourth Rule* for the attaining of *Truth*. For since the Second Operation of the Mind, or *Judgment*, doth involve two things, the *Subject*, and the *Predicate* or *Attribute*, it is necessary that the Nature of both be fully known to us, before we can judge whether the one do agree with the other, or dissents from it. Thus we must first have distinctly understood what the *Sun*, and what *Heat* is, before we can affirm the *Sun* to be *hot*, or (which is the same) that *Heat* agrees to the *Sun*. As to which point they do greatly mistake, who too much cleaving to the Prejudices wherewith they have been tainted from their *Childhood*, do judge according to them; because they pervert the Order of *Reason*, and do not follow their Perceptions as they ought to do; but anticipate them, and believe them to be true; before they have perceived them to be such.

VIII.
The Second Precept, about the manner of Knowing, is concerning Judgment.

If a Man chance to doubt of the *Truth* of the thing he is enquiring into, he may easily avoid falling into any Error, by suspending his *Judgment*, and not affirming or denying any thing concerning it, until he have exactly examin'd all the Difficulties of it, and by the *Rules* of *Perception* have

IX.
What is to be done by him who is in doubt about the Matter propounded to him.

have removed all doubts concerning it. For we must not think it enough, that this or the other thing appears distinctly and clearly to others, except it appears likewise to us. For seeing every one desires Knowledge for himself, it is but reasonable, that he make use of his own Understanding, and not of anothers; and that he pass Judgment so far only, as his own Knowledge guides him. Wherefore, before we can with any safety give our assent to any thing, we must be certain that the thing be so indeed, as it is conceived by us, and not only so, but that it cannot be otherwise.

X.
There is a
different
certainty
of Truth in
things.

Yet are not we to conceive that all things that are true, are of the same certainty; for some things are only *Contingently* true, that is, such as are taken to be true by us, tho' indeed they may be false; as when I take a Man to be *Godly*, because he is frequent at *Church*, and at *Sermons*, and is liberal to the *Poor*; all which Signs are sufficient *Morally*, to persuade me that he is *Godly*; tho' notwithstanding all this, it may happen that he is not so. Other things again, are altogether *Certain* and *True*, as are all *Propositions* of *Eternal Truth*, which are true in that degree, that they cannot admit any suspicion of *Falshood*: Such as are these Propositions, *Twice four make Eight. Three is a number.* And therefore such necessary Propositions as these are called *Axioms*; because their *Predicates* agree with all their *Subjects*, and at all times, and according to the different degree of necessity, they partake and admit of several Names.

XI.
What Phys-
ical Cer-
tainty is.

Some *Attributes* are said to be joyned with their *Subjects*, by a *Physical* certainty, when according to the order of Nature, it is impossible but they must be joyned to them; as when we say, that a *Man hath two Feet*; because, that tho' a Man may be conceived without Feet, yet Naturally Man is never without them. Other things are called true, by *Metaphysical* certainty, when an *Attribute* is so indissolubly attributed to its Subject, that it cannot be conceived to be otherways: As when we say, *Three is a number.* And the same may be said of singular *Axioms*, forasmuch as the same *Definitions*, *Differences* and *Attributes* occur in them as in *Universals*. As to Judgment, the Reader may have recourse to what hath been said in the second part of *Logick*, where is treated of *Judgment*, and the nature of *Propositions*.

XII.
The Third
Precept is
Memory.

And forasmuch as it is of little use to know the nature of things, except we remember them; we are also to be informed, how the things we understand, may be so *imprest* on our *Memories*, that we may not easily forget them again. This we may easily procure, by following the Order of our *Method*; that is, by taking care, that we commit nothing to Memory, which we have not before thoroughly examined, and passed a right *Judgment* of. For daily experience shews us, that the more clearly any thing is perceived by us, the stronger it is *imprest* on our *Memories*, and that we more easily remember the things, that are in order propounded to us, than those which are offered to us confusedly. For the *Memory* doth of it self, and spontaneously embrace things that are clearly understood, and, as a Foot-boy, follows right Judgment.

XIII.
Helps of the
Memory.

But yet we may promote and assist our *Memory*. First, By keeping our Mind still and quiet, without suffering our Understanding to be variously

distracted by multiplicity of Objects: Especially if to these we add the desire of Learning some new thing or other, or that we be excited by admiration to insist the longer on the matter we desire to know. For such things as these we are wont more to imprint in our *Memory*. It is also greatly strengthened by moderate Study and frequent Excitation. For as the *Fingers* by playing upon a *Lute*, do accustom themselves to such and such Motions, so by Exercise we attain to ability and readiness. To which we may add, that by Study, the Species in the *Brain* become distinctly ranged and joyned, and by use alone, almost all obstructions are removed. Thirdly, It will be a great help to our *Memory*, if the things we commit to it be not only evident, but also connexed, and orderly disposed, and adorned with the *Circumstances* of *Causes*, *Effects*, *Time*, *Place* and other such like. This is the first office of *Memory*.

It is the office of *Memory*, to retain the things we have committed to it; which we shall obtain by frequently repeating, and a diligent consideration of them: As likewise by endeavouring to reduce Compound Things to those that are *Simple*, and special things to *General*. For by this means, they will more clearly be represented to our *Minds*, and more firmly fixed in our *Memory*: As is apparent in those *Sciences*, which from simple terms proceed to *Propositions* and *Axioms*; which without any trouble, are insinuated into our *Minds*, and continue with us till our *Lives* end.

XIV.
The Office of
Memory.

CHAP. XXI.

Concerning special Method; and first of that which is called Analytical.

The word *Method*, is taken more strictly here than in the foregoing Chapter; because it being there, only our design to inform *Beginners*, what Order they were to observe in the knowledge of *Things*; it was sufficient to set down a *Method*, disposing which might be helpful to them for this end, and point out to them the way, whereby to arrive at the distinct knowledge of *Things*. But here we are to handle, not only how we ought to form our Conceptions, but also how we ought to order and dispose them, either for the discovering of the *Truth* we are ignorant of, or for the proving of the *Truth* we know to others.

And accordingly there is a twofold *Method*, the one called *Analytical*, or the *Method of Resolution*, which shews the true way, by which the thing was Methodically and Primarily invented. The other *Synthetical*, or the *Method of Composition*, which clearly demonstrates what hath been concluded; but by an opposit way, and fetch'd *à Posteriori*. For a whole *Science* cannot be set down according to *Analytical Method*, but only some particular *Questions*, about certain *Terms* or *Things*.

About *Terms* we may enquire, what is to be understood by the *Word* in Question; for seeing that some *Words*, belong to *Notions*, that are common to all Men; and other proper or peculiar to some that profess some certain *Disciplines*: We are to mind, what Men are wont to understand by the *Word*; or what the *Masters* of those *Disciplines* are used to signify by them; or what he means by them, who makes use of them in *Writing* or in his *Speech*. For it cannot be doubted, but that the

I.
Another
Method ne-
cessary to
the orderly
disposing
of our
Thoughts.

II.
Method is
twofold,
Analytical
and Synthe-
tical.

III.
What is to
be observed
about Terms

most

most part of our disputes arise from the Ambiguity of Words; whilst one takes them in one Sense, another in another; which disputes might easily be decided, if the Parties in contest were agreed about the signification of the Word in question.

IV.
What is to be observed about things.

About the thing it self, we are to consider *what it is*, that is, what its Essence and Properties are. *Whether it be*, that is, whether it exist in the Nature of Things; and if it do, whether its existence be possible or necessary. *Whence it hath its Original*, whether from it self, or from some other thing; and if it proceed from another, whether by Creation or Generation. Of what Nature it is, *Material or Intellectual*, and with what Faculties it is endowed, &c. Of *what quantity*, or bigness it is, and what space it takes up amongst other Bodies, if it be *Material*; and what if it be *Intellectual*, what its Powers are. *What effects it produceth*, that is, whether it be a Principal Cause, or an Instrumental only; whether it work voluntarily or necessarily; whether it be Univocal, or Equivocal, &c. *How it is distinguished from other things*, or what distinction there is between it, and other things, and whether it differ from them really, or Notionally only.

V.
What a Question is.

Analytical Method being the Art which guides Reason in the Research of Truth, we must before all things, endeavour to know the Nature of the Question, which we are to examin, and to consider afterwards, how many sorts of Questions there may be made. Questions are Propositions, which include something that is already known, and something that is unknown. For otherwise, they would be rather known Truths, than Truths to be known; and if they did not also contain something that is known, they could not properly be called Questions, because we cannot proceed to that which is unknown, but by means of something that is known.

VI.
There is a four-fold way of searching out the Truth of things: First when by the Effects we find out the Cause.

All Questions concerning things may be reduced to four Species. First, When from the Effects we find out the Cause. As for Example it is Notorious, that the Sun shining upon a Prism, represents therein variety of Colours; the Question is, what is the true cause of so many divers Effects. It is a known thing, that Air and Water are subject to Rarefaction, and that at one time they take up more space than at another: the Question is, what is the reason of this change, and what there is in Nature, that can encrease the quantity of Bodies.

VII.
The second is when from the Causes we enquire into the Nature of the Effects.

The second sort of Questions is, when Effects are endeavoured to be discovered by their Causes. It is a known thing, that Wind and Water have great force in them, to move Bodies; but our Fore-Fathers, for want of due attention, not considering duly what Effects might be produced from those Causes, did not make that good use of them, as we now do, by the useful inventions of Watermills and Windmills, and many other conveniences, by which abundance of human labour is spared, which is an advantage of true Natural Philosophy. The first sort of Questions, in which the Cause is searched out by the Effects, are the total Object of Natural Philosophy; and the second sort, in which the Effects are enquired into by the Cause, are the whole Practice of it.

VIII.
Thirdly, when from the Parts

The third sort of Questions is, when from the Parts we enquire into the Nature of the whole; as when after having set down several Numbers, by

adding them together, we enquire, what Number results from them all. Or when having got two Numbers, we enquire, what they produce by mutual Multiplication.

IX.
Fourthly, when from one Part we search into the Nature of another.

The Fourth is, when having a whole, and some part of it, we search out the other part of it: As, when having a determinate number, and that part which is to be taken from it, we enquire, what number will afterwards remain to us. By the Word Part in this place, we are not strictly to understand, only the Part of a thing, but whatsoever doth belong to any Substance, such as are Modes, Properties, Accidents, and in a Word, all the Attributes that are found in any thing.

X.
What is required to enable us to answer these Questions.

That we may be able to answer these Questions, in the First place, it is requisite, that we clearly and distinctly conceive the point, that is precisely enquired after. Secondly, that we do not precipitate our Answer, till we have discovered whatsoever belongs to the Question, by certain Signs and Tokens, and not imitate those, who hearing their Friends Name, presently conceive it to signifie that particular Person, and give their answer, before they know what he, who asked the Question, means by it. Thirdly, Forasmuch as in every Question, there is something concealed, we must be careful to denote that which is hid, by some certain Conditions, which may determine us to the seeking of one thing, rather than another, and which may induce us to judge, that that which we have found is the very same thing, that was enquired after. Fourthly, After we have examined the Conditions, let us set our selves seriously to consider, whatsoever in the matter propounded is either hid from us, or clear and evident to us; forasmuch as by means of this, we may arrive to that which is unknown to us. And in this our Attention to that which we know of a thing, in the resolving of a Question, Analytical Method chiefly consists: The whole Art and industry whereof consists in this, by this Examination to find out several Truths, which may lead us to the knowledge of that thing, which we are endeavouring to discover.

XI.
What Analytical Method is.

Analytical Method therefore is nothing else, but a Particular application of the Mind, to that which is known, of that which is most particular in the Question to be resolved; whence it successively deduceth other Truths, which lead it at last, to the thing it desires to know. I say, that Analytical Method is a particular Application of the Mind, to that which is known; to observe that which Analytical Method, hath in common with Synthetical, which also begins with that which is known. And add, of that which is most particular in the Question it would resolve. To intimate the difference that is between the Analytical and Synthetical Method; and that this latter takes that which is known, of that which is most general in the Questions; whereas the other takes it of that which is most particular in them.

XII.
How by way of Analysis we may prove the Mind of Man to be Immortal.

As suppose the Question to be whether the Mind of Man be immortal; and to find out this, we consider the Nature of the Mind, and presently discover, that Thinking is the property of the Mind of Man, which tho' it might be supposed to doubt of every thing besides, yet cannot doubt of its own Thinking, since its doubting is a kind of Thinking. Afterwards it proceeds to examin what it is to Think, and when it perceives that nothing is included

included in its *Idea*, of what is involved in the *Idea* of an *Extended Substance*, or a *Body*: Yea, that it may be denied of *Cogitation*, that it belongs to the *Body*, forasmuch as it is something extended in *Length*, *Breadth*, and *Depth*, hath *Parts*, is of such and such a *Figure*; is *Divisible*, &c. without destroying the *Idea* we have of *Cogitation*: We conclude, that *Cogitation* cannot be the *Mode* of an *Extended Substance*; because the *Nature* of a *Mode* is such that it cannot be conceived, when the thing whose *Mode* it is, is denied of it. Whence it may also be infer'd, that seeing *Cogitation* is not a *Mode* of the *Body*, it must needs be the *Attribute* of another thing; and that therefore a *Thinking Substance*, and an *Extended Substance*, are two distinct *Substances*. From which finally we conclude, that the destruction of the one, doth not infer the destruction of the other. Add also, that *Extended Substance* cannot properly be said to be destroyed, since whatsoever we may call its destruction, is nothing else but a change or dissolution of some *parts* of the *Matter*, which still remains the same in *Nature* as it was. As when all the *Wheels* of a *Watch* are broken, we may easily judge that no part of the *Watch* is destroyed, tho' the *Watch* itself be commonly said to be spoil'd or destroyed. From which *Example* it appears, that the *Soul*, which is not *divisible*, neither consists of any *parts*, cannot perish, and consequently that it is *Immortal*.

XIII.
Analytical
Method
proceeds
from a
heedful
Considera-
tion of a
thing.

Whensoever therefore the *Nature* or *Cause* of any thing is proposed to our Examination, we must in the first place accurately examine all the Conditions of the *Question* propounded, without minding such as are *Extraneous*, and do not belong to the *Question*. Secondly, We are to separate those things which are certain and manifest from those that include any thing of *Confusion* or *Doubt*: For we are to search and trace out the thing we enquire for, from clear and evident *Idea's*. Thirdly, Every Difficulty we meet with is to be divided into *Parts*, which *Parts* are to be considered by themselves. For *Partition* is like a *Torch* to a Learner, directing him which way he is to go, without uncertainly wandring up and down. Fourthly, We are orderly to dispose of our *Perceptions*, and the *Judgments* we frame thence; so that beginning from the most easie, we may proceed by degrees to those that are more difficult. Wherefore our chief business must be, diligently to consider, and well to weigh those *Particulars* chiefly, which are clear and perspicuous in the *Question*, and not proceed to those that are unknown, except we find that by those which are already known to us, we are likely to Master them. Fifthly, That the *Thing* in question, be furnish'd with some *Note* or other that may determine it, and make us judge it to be the same, whenever we meet with it.

XIV.
An Exam-
ple of the
aforesaid
Analytical
Method.

As by *Example*, it is apparent that *Water*, and all *Liquid things*, have their *Parts* in *Motion*: For we see that *Water* dissolves *Salt* and *Sugar*, which would not be, if the insensible parts of the *Water* by their continual motion, did not run against the *Salt* and *Sugar*. And if we enquire into the Cause of this *Motion*, we shall find that *Water* and other *Liquid Bodies*, are not moved of themselves, because they are *Bodies*, since all *Bodies* are not moved, and those which rest are *Bodies* as well as those which are moved. Wherefore we are to

seek for a *Foreign Cause*, which produceth *Motion* in *Liquid Bodies*, and makes them to dissolve the *Particles* of *Salt*. And finding that the *Air*, by penetrating the *Pores* of the *Water*, cannot be the Cause of this *Motion*; for whence should the *Air* have the force to agitate all the parts of the *Water*? it remains that we assign some other *Matter* more subtil than *Air*, and more fluid, which may put the *Air*, *Water*, and other *Liquid Bodies* into *Motion*, which in the General Part of our *Natural Philosophy* we shall declare to be the *First Element*. For the more subtil any *Body* is, or divided into less *Parts*, so much the more easily it is agitated, and being once put into *Motion*, doth the more easily retain it. Wherefore the most subtil *Ether*, or *Celestial Matter*, must be supposed to be the *first Principle* of *Motion*, which *Matter* abounds in the *Fire*, *Sun*, *Fix'd Stars*, *Spirit of Wine*, and other *Liquors*.

Wherefore in the *Analytical*, as well as *Synthetic Method*, we are always to proceed from that which is more known, to that which is less known. This *Rule* is common to all *Method*, neither is any to be accounted true that deviates from this *Principle*. Yet there is this difference between the *Method of Resolution*, and that of *Composition*; that in the former, the *Known Truths* used in the Examination of the thing, which is propounded to be known, are taken from *Particulars*, and from them we do (as by special Steps) ascend to *Generals*; not as is done in the latter, where beginning with *Generals*, we come down to *Particulars*. So that these two *Methods* differ, as the *Ascent* or *Descent* of the same *Hill*; or the *Way* whereby we go up from the *Valley* to the *Top of the Hill*, and again come down from thence to the *Valley*.

CHAP. XXII.

Of the Method of Composition.

THIS *Method* is called the *Method of COMPOSING*, because it makes use of *General* and *Common things*, to come to things *Particular* and *Compound*: As for *Example*, If I have a mind to reach another by the way of *Synthetic Method*, that the *Soul of Man is Immortal*, I begin with these general *Maxims*; That Every *Being* is either a *Substance*, or a *Mode*; that there are two *Substances*, viz. a *Thinking Substance*, and an *Extended Substance*; that no *Substance* can properly be said to perish; that what we call *Destruction* in a *Bodily Substance*, is only a *Dissolution* of its *Parts*: Whence I conclude, that that which hath no *Parts*, as the *Soul*, cannot be destroyed, and that by consequence it is *Immortal*.

I have said, that the *Method of Compounding* proceeds from more *Universal things*, to such as are less *Universal*; and it does so, because by this way of proceeding, all *Repetitions*, which commonly occasion *Confusion* and *Tediousness*, may be avoided. For should we treat of *Species*, before we have spoken of the *Genus*; forasmuch as we cannot know the *Species*, without knowing the *Genus* first, we should be fain to explain the *Nature* of the *Genus*, as often as we had occasion to treat of any *Species*. But because this way of *Demonstration* is peculiar to *Geometricians*, and is look'd upon by them as very necessary to persuade *Truth*, we will borrow from them whatsoever we have

XV.
In all Me-
thod we
are to pro-
ceed from
that which
is more
known, to
that which
is less
known.

I.
What use
we are to
make of
the Synthe-
tical Me-
thod.

II.
Why Syn-
thetical
Method
proceeds
from things
General, to
less Gene-
ral.

have to say concerning it, to the end that we may follow the same way in searching out the Knowledge of other things, which they use in the demonstration of Matters Geometrical.

III. *What things Mathematicians make use of in their Demonstrations.*
 Mathematicians are wont to deduce those things that are of the greatest moment and weight from known and easie Principles, by a Chain of Simple Truths; which they refer to three kinds; the first whereof includes Definitions: As, a Right Line is that which is the shortest betwixt two Points. A Point is that which hath no Parts. The second contains Postulata, or things demanded or taken for granted, which are so evident as to need no confirmation, and want nothing but the Hearers assent, viz. that from any Center, and at any distance, a Circle may be described. The Third comprehends Axioms, or common Notions of the Mind, which are not only manifest and evident in the Science we are treating of, but also in all others: As that all Right Angles are equal amongst themselves; that which is Equal, is bigger than all its Parts taken together.

IV. *Three things are required to the Extorting an Assent.*
 Hence three things are chiefly observed by Geometricians, for the forcing of Assent. First, That no Ambiguity be left in the Terms, which is easily avoided by the Definitions of the Terms, which (as was said before) are nothing else but open Explications of the Terms and Words by which the things under debate are signified. The Second is, That every Ratiocination be founded on clear and distinct Principles, being so evident, that whosoever rightly understands the Words, must needs give his Assent to them. Which is the Reason why Mathematicians do always presuppose their Axioms, which they require to be granted them, as being so evident, that they stand in need of no Explication. The Third is, That every Conclusion they propound be proved demonstratively, making use only of those Definitions they have already alledged, or such Principles as have been granted them: Or lastly, Propositions, which by force of Argument they have deduced from them. So that all which Mathematicians observe concerning this matter, may be reduced to these Heads, which we shall comprehend in the following Rules.

Rules of Definitions.

The First, That every Obscure or Equivocal Term be defined.

The Second, That no Terms do enter the Definition, which are not altogether clear, or have not been before explained.

Which two Rules are of that necessity, that they cannot sufficiently be imprinted in our Minds; forasmuch as by this means many Disputations are taken out of the way, which oft consists only in the Ambiguity of Words; as when the same Term is by divers Persons taken in a different Sense; which is a thing that happens very frequently in Schools. Wherefore, for the Removal of so many Disputations, which often do arise amongst the divers Sects of Philosophers, it will be sufficient if the Disputing Parties take care to explain distinctly, and in few words, what they conceive by the Term about which they Dispute, and what they would have others to understand by it. As for the Qualifications of the Definitions of things, of these we have treated in the Fourteenth Chapter.

The Rule of Axioms.

This is a Rule of Axioms, That no Propositions be set up for Axioms, but such as are most manifest and evident. VII. *A Rule for Axioms.*

For no body questions, but that there are some Common Notions of the Mind that are so clear and perspicuous, as to stand in need of no Demonstration, to make them appear more distinctly. For did they involve the least Doubtfulness; they could not be the Foundation of a certain Conclusion. And therefore they are called Axioms, or common Enunciations, because they are so clear and manifest, as to stand in need of no Demonstration.

But we are not to suppose, as some do, that the Certainty and Evidence of Propositions doth in any degree proceed from the Senses; for that is absolutely false. For the Truth-discerning-Faculty is not placed in the Senses, which are often deceived by a Similitude of Things, and are not able to dive into the Difference that lies hid in them. Who is it that doth not experience how narrow and weak our Senses are, and how frequently they deceive us, when we go about to search out any thing by their means?

For altho' this Axiom, That the Whole is greater than any one of its Parts, be in some sort discernible by the Senses, yet not with such a Certainty as is necessary to Science; because whatsoever our Senses discover to us concerning it, is only founded on the observations of our Infancy, which cannot afford us an undoubted, but only a probable Certainty. For by Induction a thing cannot be certainly known, except we be certain of the fulness of the Induction; there being nothing more common, than for us to discern at last the falsity of those things, which from general Inductions we were persuaded to be most True. The whole Truth of this Proposition, the Whole is bigger than its Parts, doth depend on the clear and distinct Notions we have of the Whole and Parts, by which we judge that the Whole is greater than any one of its Parts, and that the Part is less than the Whole. For when we are discoursing of any thing that is firm and stable, we must not have recourse to the Senses, as Plato saith; but to constant, immutable, and impregnable Reasons. Thus we clearly know, that a Triangle is a Figure, that the Number Two is an even Number; because the Notion of a Figure is contained in the Definition of a Triangle; and in that of the Number Two, the Notion of an Even Number.

Wherefore all the Certainty of our Knowledge in Natural things, depends on this Principle, Whatsoever is included in the clear and distinct Idea of any thing, the same may with truth be affirmed of it. Thus because Substance is included in the Conception of a Body, we may affirm a Body to be a Substance. Because it is involved in the Idea of a Circle, to have equal Diameters, we may assert of every Circle, That all their Diameters are Equal. Because it is included in the Idea of a Triangle, that all its Angles are Equal to two Right ones, we may affirm the same of all Triangles. What must be the Qualifications of Axioms, appears from what we have said of the framing of Propositions that are necessarily true, in the Thirteenth Chapter.

VIII. *The Evidence of Axioms doth not arise from the Senses.*

IX. *The Certainty of Propositions depends on the clear Knowledge we have of them.*

Met

V. *First Rule of Definitions.*
 VI. *Second Rule.*

Most General Axioms.

X.
To have
many
Axioms in
a readiness,
is a great
help to
ready Ar-
guing or
Ratiocina-
tion.

But forasmuch as it is of great use, to have good store of *Axioms* at hand, whereby to prove and discover what is obscure and abstruse; it will be necessary to set down here some general and necessary *Propositions*, from which as so many *Fountains*, more special ones as *Rivulets* may be derived.

I. *Whatsoever is comprehended in the clear and distinct Conception of any thing, the same may with Truth be affirmed of it.*

For since in the clear and distinct *Conception* of a *Body Extension* is contained, and *Cogitation* in the *Idea* of the *Soul*, I can truly affirm of a *Body* that it is extended; and of the *Soul*, that it is a *Thinking Substance*. Wherefore we are to lay down this, as the *Foundation* of all *Sciences*; that we must never give our full assent to any *Proposition*, which doth not appear evidently true to us, so as that we cannot but assent to it, without doing violence to our *Minds*.

II. *In every Idea or Conception is involved either Possible or necessary Existence.*

Since nothing can be apprehended by us, except under the notion of being *Existent*; that is, necessary *Existence* is comprehended in the notion of a *Being* absolutely perfect, that is, of *God*; and possible *Existence* in that of a *Creature*, or of a limited and finite *Being*.

III. *Nothing has no Affections or Properties.*

So it cannot be said, that nothing is *Divisible*, that it hath *Parts*, that it can be moved, &c. Wherefore, wheresoever any *Property* is found, there we may assert that there is a *True and Real Being*.

IV. *Nothing cannot be the Cause of any Thing.*

Forasmuch as the *Cause* of a *Thing* is supposed to be, before it can produce any thing, and that *Nothing* cannot exist, it doth follow, that neither can it be *Principle* or *cause* of any thing. For if *Nothing* could ever be *Something*, it would follow, in opposition to the foregoing *Maxim*, that it must have some *Property*, which is a *Contradiction*.

From this *Axiom*, some others are deduced by way of *Corollaries*; such as are,

V. *Nothing, nor any Perfection of a thing, actually Existent, can have Nothing, or a thing not Existing, for the cause of its Existence.*

Another *Corollary*:

VI. *Whatsoever Reality, or Perfection there is in any thing, the same is formally, or eminently in the first, and adequate cause of that thing.*

Whence it follows, that the *Objective Reality* of our *Idea's*, requires a *Cause* in which the same *Reality*, is contained, not only *Objectively*, but *Formally*, or *Eminently*. For this *Axiom* doth not only belong to the *Efficient Cause*, but also to the *Exemplary*. For if an *Image* be made more excellent than its *Exemplar* or *Original*, so that more *Perfections* are found in it, than in the thing it self, after the likeness of which it is made, it cannot be said to imitate its *Exemplar*, and consequently cannot properly be called its *Image*.

VII. *A Thing or Substance, cannot naturally be Annihilated.*

That is, it cannot so cease to be, as that nothing at all should remain of it. For we easily conceive,

that when any thing ceaseth to appear, it doth change its *Nature*, or is converted into another thing; As for Example, we can well enough conceive, how *Wood* comes to cease to be *Wood*, how it comes to be *Fire*, and how the several *Particles* of *Fire* are subdivided into others, that at last they cannot be perceived by any *Sense*: But we can by no means conceive, how they should be reduced naturally to nothing, and from *Being* pass, to not *Being*.

VIII. *That which is clear and evident is not to be denied, because that which is obscure, cannot be comprehended.*

For we cannot doubt, but that there is *Liberty* and *Indifferency* in us, because we are conscious of it, and comprehend nothing more evidently or perfectly, tho' we cannot comprehend, how *God* doth leave the free actions of Men indetermined.

IX. *It is the nature of a Finite Mind, to be unable to comprehend that which is infinite.*

Because it is the nature of an *Infinite being*, to be *Incomprehensible*; for if it could be comprehended, it would not be *Infinite*. What wonder is it therefore, that we cannot conceive matter to be *Divisible* into *Infinite*? Or that we cannot understand the *Mystery* of the *Trinity*, or the *Incarnation* of the *Divine Word*? Because our *Mind* is *Finite*, and bears no proportion to the *Mysteries*. Would but some Men weigh this *Axiom*, as they ought, they would not with so much obstinacy, rely upon their weak Reason, or trusting to their own Wits, invent a new kind of *Divinity*.

X. *If you take Equals from Equals, what remains will be Equal.*

XI. *If you add Equals to Equals, the whole will be Equal.*

XII. *It is in vain to endeavour that by more, which can commodiously be performed by less.*

Special Logical Axioms.

To these we may subjoin some *Logical Axioms*, which are of great use, in the guiding of our *Discourse*, and are taken from the *Genus*, *Species*, *Difference*, *Division*, *Causes*, &c. Logical Axioms are of great use.

From the Genus.

I. *Whatsoever is affirmed or denied of the Genus the same is affirmed or denied of the Species.*

The reason is, because the *Genus* contains the *Species*, and because the whole *Essence* of the *Genus* is found in them: Thus, because it is affirmed of an *Animal*, that it is *Sensitive*, the same is also affirmed of *Man* and *Beast*. And because the same *Animal* is denied to be a *Stone*, so likewise, the same is denied of a *Man* and a *Beast*. Wherefore, the *Genus* is of no use to prove the *Species*, but only to remove it. For that which is not an *Animal*, neither can it be a *Man*; but that which is a *Man*, must therefore be an *Animal*.

II. *The supposing of the Genus, doth not suppose such a Species.*

As for Example, supposing any thing to be an *Animal*, it cannot from thence be concluded, that it is a *Man*; because it may be a *Beast*, which is likewise an *Animal*.

III. *The Genus being destroyed, the Species must be destroyed with it.*

For seeing that the *Genus* is an essential part of the *Species*, it must follow that the *Genus* being destroyed, that must needs be destroyed with it, which consists of it. Thus if we take away an *Animal*,

Animal, we together take away the *Species*, that are contained under it. And by taking away a *Four-square Figure*, we at the same time take away a *Parallelogram* and a *Trapezium*, which are the *Species* of a *Four-square*.

From the Species.

I. The supposing of the *Species*, supposeth the *Genus*; but the taking away of one *Species*, doth not necessarily remove the *Genus*.

Because the *Idea* of the *Genus*, is comprehended in the *Essential Conception* of the *Species*, without which the nature of the *Species* cannot be explained. So supposing a *Binary* or the number two, we suppose a *number* also; and asserting a *Parallelogram*, we likewise assert a *Square*. And if all *Beasts* were taken out the *World*, yet would not *Animal* be therefore taken away, seeing it would be preserved in *Man*. Hence it is, that the *Species* is of great force to prove the *Genus*, but of none at all to deny it. For that which is a *Binary*, must be a *number*, but it does not follow, that that which is no *Binary*, is therefore no *number*.

II. All the *Species* being destroyed, the *Genus* is destroyed likewise.

For in this case all the power of the *Genus* is exhausted, neither doth there any thing remain, of which it can be affirmed. So supposing the *Sight*, *Hearing*, *Tasting*, *Smelling* and *Feeling* to be destroyed; the outward *Sense* must be destroyed likewise: And taking away *Prudence*, *Justice*, *Temperance* and *Fortitude*, takes away *Vertue* also.

From the Form or Difference.

I. The *Form* is that by which a thing is, what it is.

Because the *Form* or *Difference*, is the chief *Essential Attribute* that is found in the *Species*, and whose property it is to constitute the same, and distinguish it from other *Species*. Thus *Extension* constitutes a *Body*, and *Cogitation* the *Mind* or *Soul* of *Man*.

II. Where the total *Difference* or *Form* can be affirmed or denied, of the same the *Species* also may be affirmed or denied.

This *Axiom* as a *Corollary* is deduced from the former; for seeing the thing is constituted by the difference, where the same is found, it is necessary that there the *Species* be also. Thus, because *Cogitation* may be affirmed of the *Mind* of *Man*, therefore we may affirm it to be a *Thinking Being*.

III. The *Form* and *Species* are reciprocated.

The *Reason* is, because *Difference* constitutes the *Species*, and doth distinguish it from other *Species*, and therefore must have the same latitude as the *Species* it self, and therefore must reciprocally be affirmed of one another: As, *Every thing that Thinks is a Mind*, and *every thing that is a Mind Thinks*.

From the Property.

I. The *Property* is consequent on the *Form*.

For the *Property* is something flowing from the nature of the *Species*, and so bound to it, that it agrees to the whole *Species*: So *Divisibility* follows *Extension*, and is so necessarily joyned to it, that no *Body* can be extended, but that it must be *Divisible* also.

II. The supposing of the *Form*, supposeth the *Property*, and the taking away of it, takes away the *Property* also.

As when *Extension* is supposed, *Impenetrability* and *Divisibility* are supposed likewise; and if that be taken away, the *Properties* are taken away also.

From the Definition.

I. Whatsoever agrees with the *Definition*, agrees also with the thing *Defined*.

For seeing that a *Definition* declares the nature of a thing, by its *Essential Attributes*, viz. by its *Genus* and *Difference*, it must include the *Whole*, contained in the thing defined; and therefore whatsoever is *Attributed* to the *Definition*, the same must necessarily be also *Attributed* to the thing defined. Thus, because it agrees to the *Art of Discoursing well*, to direct the *Mind*; therefore also it must agree to *Logick*, to direct the *Mind*.

II. If the *Definition* belong to a thing, the thing defined must also belong to it.

Thus, because it belongs to the *Mind* of *Man*, to be a *Thinking Substance*, it belongs also to the same to be a *Spirit*. And because to a *Stone*, belongs *Extension* in *Length*, *Breadth* and *Depth*, therefore it also belongs to it, to be a *Body*.

III. If a *Definition* agree with a *Definition*, the thing *Defined* also, must agree with the thing *Defined*.

As, That which consists of a *Body* and *Mind*, is endowed with *Sense*; therefore *Man* is an *Animal*. *Substance* is something which hath an *Essence* and *Existence* distinguished from all other things; and on the contrary.

From Division.

I. If no part of the *Division* agrees to a thing, neither doth the thing divided agree with it.

Thus, because the notion neither of a *Spirit* nor *Body*, doth agree to *Substantial Forms* (save only the *Soul* of *Man*.) Therefore, *Substantial Forms* cannot be *Substances*.

II. Every *Division* must be entire, that is, it Enumerates all and every *Part* belonging to a thing.

For should any part belonging to a thing, be omitted in the *Division*, there could not be an Adequate Enumeration of the *Parts*, neither consequently would the thing, by means of such a *Division*, be distinctly perceived. Thus the *Division* of a *Man* into *Sound* and *Sick*, is not Adequate, because there is a kind of *Middle State*, as, is that of a *Man*, that is recovering from *Sickness*. But the *Division* of *Hand* into *Right* and *Left*; of a *Line* into *Right* and *Crooked*; of a *Number* into *Even* and *Odd*, is Adequate because it Enumerates all and every *Part*.

III. The *Parts* of a *Division* must be opposite.

This *Axiom* follows from the foregoing. Thus things are better divided into *Material* and *Immaterial*, than into *Visible* and *Invisible*; because some *Invisible things*, as a very clear *Air*, and our *Breath*, are not by nature distinct from *Visibles*.

From the Cause.

I. The *Cause* is always before the *Effects*.

For seeing the *Cause* is that from which a thing hath its Original, or that of which that *Being* doth in some sort depend, therefore it must needs exist before it. So a *Carpenter* is before the *Building*; A *Father* before the *Son*, &c. A *Cause* is in a twofold *Sense* said to be before its *Effect*, viz. by a *Priority* of *Nature* and *Time*. A *Cause* is before its

its *Effect* by a Priority of *Nature*; because the *Effect* exists by the Power of the *Cause*, and not the *Cause* by the power and virtue of the *Effect*; yet not always by priority of *Time*, because some *Effects* exist at the same time with their *Causes*, as all those *Effects* which proceed by Emanation; as the *Proprieties* do from their *Subjects*, which therefore exist the same moment with them.

II. Nothing can be a Cause of it self.

For seeing there is a Dependance in the *Effect*, whereby it proceeds from something that was before it; it cannot be conceived, how any thing should be prior to it self.

III. Supposing the Cause in Act, we suppose the Effect in Act also.

The Reason is, because when the *Cause* is constituted in *Act*, it always does something, and that which it does is called its *Effect*. As supposing God a Producer, we must necessarily suppose something produced; and therefore the *Cause* and its *Effect*, as well as other *Relates*, are said to be *simul Natura*, that is, to be both at once; for no sooner is one *Relative* named, but at the same time we understand the other. So he is a *Father*, who hath a *Son*; and he a *Son*, who hath a *Father*.

IV. A Cause cannot give that which it hath not.

For a *Cause* gives something to another thing, but it cannot give that which it self wants.

V. Whosoever Acts by another, is esteemed to act of himself.

As he who desires, exhorts, and adviseth others to commit some Wickedness, is said to be the *Moral Cause*; because by Desiring or Commanding, &c. He makes the *Effect* to be imputed to him.

From the Effect.

I. The Effect is posterior to its Cause.

This *Axiom* follows from the foregoing: For if the *Cause* be before the *Effect*, it follows that the *Effect* must presuppose it.

II. No Effect exceeds the virtue of its Cause.

For seeing the *Effect* borrows its Being from the *Cause*, it is impossible it should take any thing that goes beyond or exceeds the Power of its *Cause*. For *Fire* would never be able to warm the *Hand*, if to warm did exceed the virtue of *Fire*.

III. That because of which every thing is such, is it self more such.

That is, if the Nature of the *Effect* be good or bad; the same doth more clearly appear in the *Cause*. This is true when both are capable of the same *Quality*: Thus because the *Kettle* is hot because of the *Fire*, the *Fire* must needs be more hot. But we cannot argue, a *Man* is satiated with the *Meat* he eats, therefore the *Meat* is more satiated.

From the Subjects, and Adjuncts.

I. Where the Subject is, there are the Adjuncts also.

For seeing that the *Adjunct* is the Mode of the *Subject*, it does always accompany the same: As where the *Fire* is, there is *heat*; where a *Dead Carcase* is, there is a *stink*.

II. Such as the Subject is, such are the Adjuncts.

For such as the *Orator* is, such is his power in Persuading; as the *Sick* is, such are his symptoms.

III. Where the Adjuncts are, there is the Subject.

Because *Adjuncts* are added to the *Subject*, and are considered as things that belong to it. As where *Motion*, *Magnitude*, &c. is found, there must also be a *Body*.

From the Whole.

I. What agrees to a Similar Whole, agrees also to the Parts of it.

For seeing that a *Similar Whole* is made up of a Conjunction of *Similar Parts*, it must needs be of the same Nature with them. Thus, because *Lead* is heavier than *Brass*; therefore every part of *Lead*, proportion being observed, must be heavier than *Brass*.

II. Where any Whole is, there are all its Principal Parts.

For the *Principal Parts* are Essential to the *Whole*. I say, the *Principal Parts*, as the *Head*, and the like; because there are some *Parts* which belong to the *Entireness*, but not to the *Essence* of the thing.

III. The Entire Whole being supposed, all its Parts are supposed also.

The Reason is, because this *Whole* is nothing else than the *Parts* taken all together: As where the *Entire Body* of *Man* is, there must be its *Skin*, *Bones*, *Sinews*, *Veins*, *Flesh*, and all things that belong to the *Entireness* of it.

From the Parts.

I. Every Part, with respect to its Whole, is Imperfect, and Incomplete.

So the *Soul* and *Body*, with respect to a *Man*, are Imperfect and Incomplete; because they both belong to make a *Perfect Man*. So the *Hands*, *Feet*, *Head*, which are the *Integral Parts* of *Mans Body*, are more Imperfect than the *Whole Body*.

II. Where all the Parts are, and joyned together, there is the Whole.

This *Axiom* is evident from what hath been already said.

From Like and Unlike.

I. Like do agree with Like.

A *Prince* must govern a *Commonwealth* after the same manner, as a *Father* of a *Family* takes care of his *Family*.

II. To Unlike things, Opposits do agree.

As we love an *Honest man*, so we hate a *Wicked person*. A *Shepherd* feeds his *Sheep*, an *Hireling* neglects them.

From Relates.

I. Relates are by Nature together, or at one and the same time.

For seeing that every *Relation* is mutual, and one *Relative* respects the other; it cannot be, but that if you put the *Relate*, you must put the *Correlate* likewise: And therefore the *Cause* and the *Effect*, that which is before, and that which is after, and all other things that do mutually respect each other, are always at once and together in the *Mind*. From whence follows also this *Axiom*.

II. One Relative being put, the other is put also; and being taken away, the other is so likewise.

From

From Contraries.

I. *That which is susceptible of one Contrary, is also susceptible of the other.*

As *Water* can be made *hot*, therefore it may also be made *cold*. A *Dog* cannot act justly, and therefore neither unjustly.

II. *Of Contraries, it is necessary that the one be in the Subject susceptible of it; the other not.*

Thus if a *Number* be not *Even*, it must be *Uneven*. Yet this *Axiom* doth not hold in all *Contraries*; for it is not necessary that a *Wall* should be *white*, because it is not *black*.

From Privative Opposits.

I. *If the one be Absent, the other must be absent also.*

This must be understood in a Capable Subject. As if a *Man* sees, he is not *blind*. It is *Light*, therefore not *Dark*.

II. *For the Most part, there is no going back from a Privation to a Habit.*

As from *Death* to *Life*, from *Blindness* to *Sight*.

III. *What in one Subject is Privation, is often a Negation with regard to another.*

This appears in our *Errors*; which with reference to *God*, who doth not bestow upon us the whole knowledge of *Truth*, are only called *Negations*; but with reference to us are *Defects* and *Privations*. Thus *Ignorance* of the *Laws* is blame-worthy in him, who professeth skill in *Law*; but not to him who is of another Profession.

From Contradictories.

I. *One Contradictory being put, the other is removed; and on the contrary.*

As supposing that *Peter* walks, it cannot be that he should not walk.

From Parity, or Equality.

I. *Even things with Even things agree, or disagree.*

As *Faith* to the *Patriarchs* was necessary to *Salvation*; therefore to us also.

From the Greater.

I. *If that which is more Likely is not; much less that which is less Likely.*

As if a *Woman* could not be tempted to *Sin* by an hundred *Guineas*, much less by thirty.

From the Lesser.

I. *If that which is less Likely is, much more that which is more likely.*

As, a *Man* hath kill'd the *King*, therefore he will make no difficulty of killing one of his *Fellow-Citizens*.

From Divine Authority.

I. *The Testimony of a Being Sovereignly Intelligent, Wise, and True, is of greater efficacy to persuade, than any other the most strong and evident Reasons that may be.*

Thus since *God* tells us, that they are *blessed* who are *persecuted for Righteousness sake*, we are to hold it for an undoubted *Truth*; because we have a greater Certainty, that he who is *Sovereignly Intelligent*, and *Infinitely Good*, cannot be deceived, than we can be certain that we our

selves are not deceived, even in those things that appear most clear and evident to us. For we are to give credit to the *Divine Testimony*, not because of the *Affirmation* or *Negation*, but for the Authority of the *Witness*, as being *Omnipotent*, *Omniscient*, and of the most *Sovereign Veracity* and *Truth*.

From Human Authority.

I. *We ought not to oppose that which is owned by all Men, or most Men, or wise Men, or by the most Famous and most Approved of them.*

As for Example, it is a *Truth* received by the common consent of all Men; that we ought to venture our *Lives* for the welfare and safety of our *Native Country*: And that it is the Duty of every *Man*, to live honestly, to hurt no body, and to give to every *Man* his Right. For this unanimous Agreement of all Men shews, that their Judgment in these Cases proceeds from common inborn Notions, and not from any Compact to impose upon others, or deceive themselves.

But yet we must not have the same Opinion of those Men, who being over-credulous, deceive others, by reporting *Prodigies* which they had from others; as that there are *Sciopodes*, Men that have but one Foot, and that so great, that lying on their Backs they can shade their whole Body with it; or that there are Men that have so great Ears, that they reach down to their Feet, and so broad that they can lye upon them; and others again that have no Heads, and have their Eyes about their Shoulders: Because we are not to believe every one, but only those whose sufficient knowledge of the Matters they relate, and Veracity, are fully known to us.

Two Rules of Demonstrations.

I. *All Propositions that involve any thing of Obscurity, are to be proved without alledging any thing in proof of them, besides Definitions which have gone before, or Axioms that have already been granted, or Propositions before demonstrated, or the Construction of the thing in discourse, when any Operation is to be done.*

II. *We are never to make an ill use of the Equivocation of Terms.* This may be occasioned by not adding their Definitions, to restrain or explain them. For to every true Demonstration two things especially are required. First, That in the Matter it self nothing be contained, but what is certain and indubitable: The Other, That there be no fault in the Form of Argumentation: Which Faults we shall avoid by the Rules now given, that is, by not making an ill use of *Equivocal Terms*, and by using no other Propositions in our Demonstrations, but what are either Definitions of Terms before explained, or Axioms that have been before granted, and which ought not to have been supposed, without being sure of their Evidencē; or Propositions, that have been before demonstrated; or the Construction of the Thing of which we treat, when any operation is to be performed. For by observing of these things all Defects or Mistakes will be easily avoided both in Matter and Form.

As to the Constitution of Demonstrations, we have handled it in the Nineteenth Chapter of the Third Part.

C H A P. XXIII.

Of Genetical Method.

I.
Themes are
two-fold,
Simple or
Conjunct.

HAVING largely enough, as I suppose, spoken of *Method in general*, and of *Analytical* and *Synthetical* in particular, it may now be fitting to subjoin something concerning *Genetical Method*, because it is of use, and belongs to the true Practice, or Exercise of *Logick*. *Genetical Method*, teacheth us to frame a *Discourse* upon any *Theme*, and takes its Name from *Genesis*, because it is as it were a new *Generation* of a *Thing*, and that whereby we Elaborate a *Theme*, that hath not as yet been Explained, or Demonstrated. And for as much as the *Theme*, or Matter proposed to be known, is either *One* and *Simple*, or *Conjunct* and *Complex*; as when for Example, I consider *God*, or the Power of *God*, in Creating the *World*, I consider something that is *Simple* or *Incomplex*: But when I set before me this Sentence, *God Created the World* (or any other Proposition, whereby any thing is affirmed or denied of another) I think of something that is *Conjunct* or *Complex*.

II.
How we are
to handle
a Simple
Theme.

The handling of a *Simple Theme*, consists in the seeking of *Arguments*, that may declare a *Simple Theme*, and the disposing of them in a due order. *Arguments* shew us the manner of inventing the *Definitions* of *Single Terms*, such as are the *Cause* and *Effect*, *Genus* and *Species*, the *whole* and its *Parts*, *Subject* and *Adjunct*, *Opposits*, *Divers*, &c. As for Example, if any one seeks for the *Efficient Cause* of *Man*, he must have recourse to the *Definition* of the *Efficient Cause*, which is, *that from which a thing by true Causality doth proceed*: Which *Definition* of the *Efficient Cause*, if it be referred to *Man*, presently, either *God* will be brought to his *Mind*, by whom he was Created presently after the *Beginning* of the *World*; Or his *Parents*, by whom all other *Men* since have been produced. And after the same manner he may find out the Matter of which he is made, the Form by which he is distinguished from all other things; and the End for which he was Created by *God*.

III.
How the
Effect: are
shewed.

So likewise the *Effects* of *Man* are manifested by examining the *Works* that proceed from *Man*, as the *Efficient Cause*, &c. and in like manner handle the rest, as far as the *Theme* propounded will bear: For it is evident, that all *Themes* will not admit the same *Arguments*; seeing *God*, for Example, hath neither any *Efficient Cause*, nor *Form*, nor *Matter*, and therefore the same cannot be considered of in him. The same may be said of the *Angels*, and the *Mind* of *Man*, which have neither *Matter*, nor *Form*, nor consist of any *Parts*.

IV.
In a Simple
Theme
we are to
examine the
Word.

In the handling of a *Simple Theme*, this order is commonly observed, as far as the nature of *Argument* will permit: *First*, To examine the *Word* of the *Theme*, whether it be derived, and if so, to give its *Etymology*: *Secondly*, Whether it be Ambiguous, and then its various *Significations* are to be Enumerated and expounded. *Thirdly*, Whether it be *Abstract* or *Concrete*.

V.
The Genus.

In the Second Place, we must enquire into the *Genus*, from the *Predicamental Table* set down in the *First part*, Chap. V. which represents all the *Genera* and *Species*, which conduceth much to the

knowledge of the *Theme*, forasmuch as the manner of handling *Themes* varieth according to the Diversity of the *Genera*.

Thirdly, We must enquire into the *Causes*, which we have set down and Enumerated, *First part*, Chap. IX.

Fourthly, The *Effects* are to be considered; not every one, but such as are Memorable, and worth the Mentioning.

Fifthly, The *Adjuncts* are to be handled according as the *Theme* is, whether *Universal* or *Proper*; as also the *Antecedents* and *Consequents*.

In the Sixth Place, *Definition*, which, as soon as we have found out the *Genus* and *Difference*, doth present it self unto us.

Next comes *DIVISION*, whereby the *Subject* is divided into its *Integral Parts*, if the *Theme* be an *Integral Whole*; or into *Species*, if it be a *Genus*.

In the Eighth Place, *COMPARATES*, or *Things* that agree in *Quantity* or *Quality*.

Lastly, *OPPOSITS*, are subjoined to all these, and are of considerable use, according to that common Saying, *Contraries set together, Illustrate each other*.

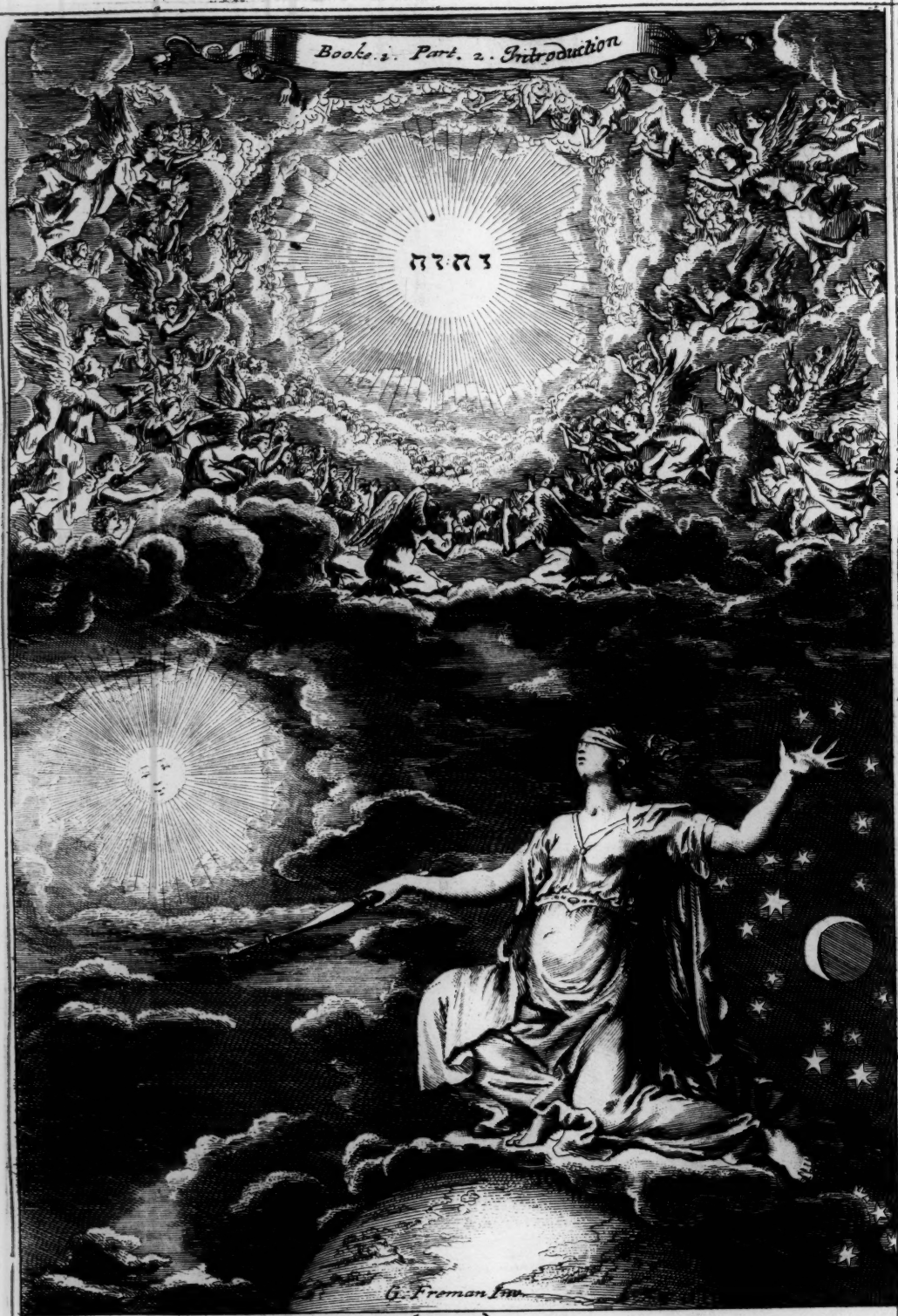
A *Complex Theme*, or *Proposition* is Genetically Demonstrated from the *Subject* and *Predicat*, which as two *Integral Parts* do constitute the same. Because by them we judge, whether a *Proposition* be *True* or *False*, *Universal* or *Particular*, *Necessary* or *Contingent*, *Affirmative* or *Negative*. As suppose this *Conjunct Theme* be to be proved, *Man is Created after the Image of God*, we are to consider both the *Parts*, viz. the *Subject Man*, and the *Predicat*, the *Image of God*, after which *Man* is said to be Created: Next the *Quantity* and *Quality* of the *Proposition* are to be Examined: And Lastly, The *Reasons* or *Arguments* of the *Affirmation* are to be investigated from the nature of the *Subject* and *Predicat*.

The *Subject Man* furnisheth us with *Reasons* or *Arguments*. First, From the *Efficient Cause*, because the *Holy Trinity* entred as it were into Consultation about the *Creating* of *Man*, which was not done in the other *Works* of the *Creation*, which is an *Argument* of a peculiar *Prerogative* of *Man*, before other *Creatures*, which consists in that he is an *Image of God*. Secondly, From his *Matter*, because he is made with a *Face*, directed towards *Heaven*, &c. Thirdly, From his *Form*, because he only of all sublunary *Creatures*, had a *Mind* breathed into him. Fourthly, From *Singular Effects*, which are the *Evidences* of a peculiar *Virtue* bestowed upon him. Fifthly, From his *Adjuncts*, because he excells all other *Creatures*, by the Power he has of *Understanding*, and determining himself. Sixthly, From his *Definition*, because he is a *Substance* consisting of *Mind* and *Matter*. Seventhly, From the *Place* of *Comparats*, because he comes near to the nature of the *Angels*; and Ninthly, From that of *Opposits*, because he is not a *Beast*, devoid of *Reason*.

The *Predicat*, made after the *Image of God*, doth also afford us *Arguments* taken from the *Nature* of the *Divine Image*; viz. from its *Formal Reason*, or from its *Effects*, *Adjuncts*, *Parts*, *Definitions*, *Comparats*, *Contraries*, &c. which *Theology* handles at large.

THE

VI.
The Causes.VII.
Effects.VIII.
Adjuncts.IX.
Definition.X.
Division.XI.
Comparates.XII.
Opposits.XIII.
How a
Conjunct
Theme is
to be demonstrated.XIV.
How the
Subject is
to be considered.XV.
How the
Predicat
is to be considered.



To the Honourable
Arch Deacon.

This Plate is
by Richard



- Dr. John Fielding -
- of Dorset &c. -
- humbly Dedicated -
- Blome -

The Second Part

OF THE

INSTITUTION

OF

PHILOSOPHY.

Viz. Natural Theology,

OR, A

TREATISE

CONCERNING

G O D.

An Introductory Discourse

Of the Definition of Natural Theology, and its Certainty.

I.
Why Natural
Theology is set
before the
other parts
of Philo-
sophy.

SOME, it may be, will find it strange that I have given NATURAL THEOLOGY the precedence before other Parts of *Philosophy*, and that I betake myself to the demonstration of the *Existence* of GOD, and of his *Perfections*, before I have handled the Nature of *Corporeal Things*. But their Wonder will cease, if they consider how necessary *Natural Theology* is to other *Disciplines*, and of how great concern the knowledge of the *Divine Existence* is, for attaining a firm and evident *Knowledge* of all other Things. For seeing that GOD is the *Author* of the *World*, and all things that are in it, and the *Original* of all *Truth*, the *Knowledge* of him is to be premised, of whom all *Certainty* and *Truth* of *Science* doth so closely depend, as that without it no *Evidence* or true *Knowledge* at all can be had. For since *Science* cannot be had but from *First Causes*, how will the same be attainable by us, if we do not know them? Seeing it is the Nature of *First Principles* to be *Clear* and *Evident*; and that the *Knowledge* of other things do so depend upon them, that tho' *Principles* may be known, tho' the *things* be unknown; yet the *things* themselves can never be known, except the *Principles* be known: Seeing therefore that GOD, the *Author* of *All Created Beings*, is (according to *S. Austin*) the *Light* of all things knowable, and the *Good* of all

things to be done; we must *Know* him, before other *Causalities* can either have a *Being*, or be exactly known by us.

Notwithstanding that *Geometrical Demonstrations* be of that *Evidence* as to force our Assent, and being once clearly perceived, do no longer leave any place for doubting, as long as we attend to them; yet will they cease to appear such, if we be ignorant of the *Existence* of *God*. For how can we know, but that we are made with such *Natures* as to be deceived in those things that appear most evident to us? For we cannot be convinc'd to the contrary, except we first know *God* to *Exist*, and that He is the *Fountain* of all *Truth*, and hath not given us such *Understandings*, as to be deceived in the *Judgments* we make of things that we do most clearly and distinctly comprehend.

True it is, that our *Mind* is conscious to several *Idea's* in it self, in the *Contemplation* whereof it never finds it self deceived, as long as it neither affirms nor denies ought concerning them. It is certain also, that it finds in it self *Common Notions*, whence it frames several *Demonstrations*, which it persuades it self to be very true, as long as it gives heed to the *Premises* from whence it deduceth its *Demonstrations*. But because it cannot continually give its attention to them, and often forgets them, it may afterwards easily come to doubt

II.
All Geometrical Demonstrations derive their Evidence from the Existence of GOD.

III.
We cannot be certain that any Conclusions are true, but only so long as we do give heed to the Premises.

of their certainty, if it have not a clear and distinct Conception of God, that is, except it be assured that God is True, and that it is repugnant to his Nature to be a Deceiver. For as *Cartesius* saith in his Fifth Meditation, *Tho' I am of that Nature, that as long as I clearly and distinctly perceive any thing, I cannot but believe it true; yet because I am also of that Nature, as not to be able always to fix the intention of my Mind, upon one and the same thing, in order to my clear perceiving of the same, and that I oft call to Mind a Judgment I have made before, when I no longer attend to the Reasons, upon which I judged it to be such, other Reasons may be alledged, which might remove me from my Opinion, if I were Ignorant of the Existence of God; and consequently, should never have any true or certain Science concerning things, but only Fleeting and Mutable Opinions.*

IV.
This confirmed by
an Exam-
ple.

Thus he who considers the Nature of a Triangle, is indeed forced to conclude, that its Three Angles are equal to Two right ones, neither can he think otherwise as long as he attends to its Demonstration: But yet as soon as he turns the bent of his Mind from it, tho' he remembers that he hath clearly perceived it, yet he may easily question the truth of it, if the Existence of God be unknown to him.

V.
An Objection
on taken
from Atheists.

If it be said that *Atheists*, who deny the Existence of God, do notwithstanding clearly understand general Axioms, such as these, *Equal Quantities added to Equal, make the whole Equal: Those things which agree in a Third, do agree amongst themselves; and such like: From which they easily Demonstrate, that the Three Angles of a right Angle, are Equal to Two right ones.* And that it is a thing apparent to all that are skilled in the Principles of Geometry, that the Square of the Basis of a Triangle, is equal to the Square of the Sides: So that it is possible to have true knowledge, without supposing the knowledge of God.

VI.
Answered.

I Answer, That it cannot be denied, but that *Atheists* have a clear knowledge of Geometrical Demonstrations, and that they are so evident, as to force their assent: But yet this knowledge of theirs cannot be said to be true Science, founded upon certain Principles: Because no knowledge deserves the name of Science, that can in the least be called in doubt, and whose certainty doth not depend on an evident Principle. Now forasmuch as these Men are supposed to be *Atheists*, neither can they be certain that they are not mistaken in those very things, which they think themselves to have most clearly apprehended. And tho' it may be this doubtfulness do not trouble them at present, yet it may hereafter, upon their examining of the matter, or upon its being started by others; neither can they ever be secured from this Hesitation, without owning God to be the Author of their Being.

VII.
Natural Theology
influenceth
all human
Disciplines.

NATURAL THEOLOGY Transcends all the Parts of Philosophy; and as the Sun, that Enlightens all the World, is diffused through all Arts, and Sciences: For who is there, that considering the Works of God as he ought, doth not admire his Power, Goodness and Wisdom, and is not raised thence to the Knowledge of Him? Do not the Earth, the Water, Vegetables, Animals and Stars, all lead us to the Understanding of Him? For all things have relation to God, as to their First Principle, and proclaim him to be the one

Supream cause of their Being. For how is it possible for him, who attentively considers the Connexion of Bodies, the Motion of the Stars, the Vicissitude of Seasons, the Succession of Generations, the orderly Disposition of the Parts of the World, not to discern the Wise Author and Orderer of all these?

Bodies have no power to move themselves; how can therefore their so orderly Motion be performed, but by some Intellectual Being, by which as their Effective Principle, they are disposed, and directed to their appointed end? Wherefore *Lactantius* was of Opinion, that no Man could be so Ignorant or Savage, but that, lifting up his Eyes to Heaven, tho' he may not know by whose Providence all these things are governed, yet must needs understand from the Motion, Disposition, Constancy, Usefulness, and Contemperation of things, that they are under a wise conduct; and that it is impossible, that what is so wonderfully framed and ordered, must be managed, by the highest Counsel and Wisdom.

From what hath been said it appears what Natural Theology is, viz. the Knowledge or Science of God. For Theology is divided into Natural and Supernatural; Supernatural is called that which is fetched from Holy Scripture, and which, by the assistance of Supernatural Light, attains Divine Truths: Natural, is that, which declares and demonstrates the Existence and Attributes of God, from the Book of Nature, and from Principles, derived from the Light of Nature.

Wherefore, this Natural Theology is very profitable for Unbelievers, and Wicked Persons, that are Theoretically so, who cannot be brought to any Religion, except it be first demonstrated to them, that God Exists. As also for those who are Practical Atheists, that is, who live, as if there were no God, no Providence, no Reward after this Life, nor any Punishment; for how will these be able to defend this their Opinion, after that they are once convinced, that there is a God, and that his Attributes, are not only shadowed out in all things throughout the whole World, but besides are most clearly represented in their own Souls?

The Certainty of Natural Theology doth plainly appear, in that it is required to the laying of the Foundations of Human Disciplines, and in that without the knowledge of God, no solid Knowledge can be had of any thing whatsoever. He cannot be called a Philosopher, who is destitute of the knowledge of God, and who doth not worship him as he ought. Hence *Des Cartes* 1. Princ. Artic. 29. proves the certainty of the Natural Light given to him by God, by this Argument, because God is True, and that he is the Original and Principle of our Intellect.

CHAP. I.

What God is, and how he may be reached by us.

Forasmuch, as according to the Rules of Logick, we are never to enquire, whether a thing be, before we conceive what it is: I suppose it needful to examin, what the Nature of God is, and what is included in the Essential Conception of him, before that I proceed to the Discussing of the Point, how his Existence comes to be known to us.

The

VIII.
The rest of
Bodies
proves an
Intellectual
Principle.

IX.
What Na-
tural The-
ology is.

X.
How useful
the same is
to Atheists
and ungod-
ly Men.

XI.
The Cer-
tainty of
Natural
Theology.

I.
We are to
enquire
what God
is, before
we enquire
whether he
is.

II.
All Men
agree in
the know-
ledge of
God.

The first of these will not be difficult, if we only follow the *Judgments of Men*, that ever had any Opinion of *God*: For I believe, that Men do less disagree in this, than in any other Opinion whatsoever. There is no Man that ever heard any thing of *God*, but doth acknowledge him to be a *Substance Infinite, Independent, of the Highest Understanding and Power*, and the *Creator of all things* that are. Or if he doth not distinctly conceive thus much, yet at least must own, that all Perfections that can possibly be conceived by Man, do belong to him in the highest and most perfect manner that can be.

III.
Tho' God be
infinite, yet
doth he not
therefore
exclude all
Finite Be-
ings.

It may be some will here Object, that if *God* be an *Infinite Being*, or such a one as comprehends all manner of *Perfections* whatsoever, he must necessarily exclude every *Finite Being*, and so nothing would exist besides him. But the Fallacy of this *Reasoning* is apparent; for we cannot conclude, that, because a Man hath a more excellent Wit than others, that therefore others have no Wit at all. Or supposing his Wit to encrease to *Infinity*, would this diminish the less Portion of Wit posselt by others? Thus, tho' *God* be consummate in all manner of Perfections, yet doth not he therefore exclude all other *Beings*; except we should conceive *God* to be *Corporeal* and *Material*; for indeed if he were *Corporeally Infinite*, he must exclude all other *Bodies*. But if we should conceive *God* to be *Corporeal*, we cannot suppose him *Infinite*, that is, comprehending all manner of *Perfections*, because then he would be *Divisible*, and lose his highest Simplicity and Unity.

IV.
Gods Per-
fections are
only Infi-
nite.

But some will urge further, that it is of the Nature of a most perfect *Being*, to include all manner of *Perfections*, and therefore it is necessary for him, formally to comprehend whatsoever *Perfection* is in the *Creatures*. To which I Answer, That the *Antecedent* is false, for seeing that the *Perfections* of the *Creature* are *Finite* and imperfect, they cannot be in *God*, because otherwise *God* could not be the most Perfect *Being*, as containing imperfections in himself. Wherefore we ought rather to say, since *God* is the *Highest Being*, he includes only *Infinite Perfection*, and excludes all other.

V.
How God
is said to
be Infinite.

God is said to be *Infinite*, because he is without all *Bounds*, not only as to his *Essence*, but also as to his *Duration*, as being a necessary *Being*, and Subject to no Change or Mutability.

VI.
God is In-
dependent.

He is said to be *Independent*, because he derives his *Being*, from none besides himself. Which yet is not so to be understood, as if *God* did depend of himself, as of an *Efficient Cause*, since it might be still further enquired, whether that Cause had its *Being from it self* or *from another*. But that he is posselt of so great and immense a *Power*, that he doth not stand in need of the help of any *Being*, for his *Existence* and *Conservation*; and that therefore in some *Sense*, *God* may be said to be the *Cause* of himself.

VII.
In what
Sense God
is said to
be Positive-
ly of him-
self.

You will say, that *Divines* will not allow this way of *Speaking*, as abhorring to admit the notion of *Causality* in *God*; and therefore when they would explain How *God* is from himself, they say, that that ought only to be understood *Negatively*, that is, *God* is not of another, but by no means positively of himself, as of a *Cause*.

I Answer, That it is true, that *God* is of himself

Negatively, or which is the same thing, that he is not beholden to any *Cause* for his *Existence*; but withal do assert, that this *Negation* is not sufficient to explain the Nature of *God*, without admitting something that is positive, by which he continues to be or exist; and this we say is nothing else but his *Inexhaustible and Incomprehensible Power*; for it is certain that the *Power, Efficacy and Vertue* which we conceive in *God*, is the most Positive, Perfect and Real that can be: And therefore, forasmuch as *God* exists by reason of his *Nature*, or the *Perfections* that are in him, who can question but that he is positively of himself? For if the first Man had been from *Eternity*, so as nothing had been before him, yet forasmuch as the *Parts of Time* in which he *Exists*, may be separated from each other; and because from his *Being* to Day, it doth not follow that he shall be to *Morrow*, except there be some cause to renew him, and as it were, to produce him anew every *Moment*; we make no difficulty to assert that the *Cause* which thus preserves is something *Positive*. Thus notwithstanding *God* hath been from *Eternity*, yet because he himself preserves himself, we may conclude he is of himself, not only *Negatively*, but *Positively*, inasmuch as his *Immensity* is the *Cause* of the *Perseverance* of his *Being*.

But you will say, if *God* be positively of himself, he will be his own *Cause*, or the *Cause* of himself, since he does the same with reference to himself, what the *Efficient Cause* doth with respect to its *Effect*. Now to say, that *God* is the *Cause* of himself, sounds harshly in the *Ears* of some *Divines*, and is looked upon as an Error.

I Answer, that *God* may be said, in some manner to be the *Cause* of himself, inasmuch as he is positively preserved by himself, as long as by the word *Cause* we do not understand the *Efficient*, but only the *Formal Cause*; so that the meaning of that Expression will be no more than this, that the *Immensity* of the *Divine Essence*, is the Reason why he doth not stand in need of any *Cause* for his *Existence* or *Conservation*; or that the *Divine Perfection* is so great, that he has the Reason of his own *Existence*, not diverse, but inseparable from himself. Which is not so to be understood, as if *God* by a Positive *Influx* did conserve himself, as all *Created Beings* are conserved by him; but only that this supreme *Power*, and the *Immensity* of his *Essence* is such, that he stands in need of no *Conservator*. But now who will pretend, that this *Immensity* of the *Divine Power* is not a most positive thing? When therefore it is demanded why *God* *Exists*, we must not answer, by an *Efficient Cause*; because that is properly called an *Efficient Cause*, where the *Cause* is distinguished from the *Effect*, and where the *Effect* is supposed different from the *Cause*; but we are to Answer, by the *Essence* of the Thing or the *Formal Cause*, which bears some *Analogy* with the *Efficient*.

GOD is also acknowledged to be a *Being* of *Soveraign Wisdom* and *Understanding*, because nothing is hid from him, and because all past, present and future things are *Naked*, and open before him.

Moreover *God* is acknowledged to be most *Powerful*, because he Rules over all, and can produce whatsoever doth not imply a *Contradiction*.

VIII.
This argu-
ment fur-
ther urged.

IX.
Answered.

X.
God is con-
ceived by
all as su-
premely In-
teligent.

XI.
As most
Powerful.

He

C H A P. II.

By the Inborn Idea that is in us, we know that GOD exists.

BY the word *I D E A*, we understand that form of our Cogitation, by the immediate apprehension whereof we are conscious of the said Cogitation: So that we can express nothing, without having formed an *Idea* before of it in our *Minds*. Or to express it shorter, An *Idea* is nothing else but the thing it self perceived or thought of, as it is Objectively in the Understanding. Wherefore every *Idea* includes two things, the one *Formal* or *Proper*, inasmuch as it is an Operation of the *Mind*; the other *Objective*, as it is the Image of a *Thing* thought, or is instead of it.

In the *Second* place we are to take notice, That tho' there is no inequality in the *Idea's* of our *Mind*, as they are *Modes of Thinking*; yet are they very different with respect to the things which they represent. For it cannot be question'd but the *Idea*, which represents *Substance* to me, contains more Objective Reality, than that which represents a *Mode*, or any thing else adventitious to a perfect or compleat *Substance*. And so that *Idea* which represents to me an *Infinite Being*, *All-powerful*, *All-wise*, *Eternal*, &c. doth undoubtedly contain more Objective Reality, than that which expresseth *Substances* that are *Created*, *Dependent*, *Mortal*, &c. For seeing that these *Idea's* are something, they must have a Cause of their Existence, and consequently have so much the more Reality, as the things they represent have of *Emity*.

Thirdly, we are to observe, That there is nothing found in any *Effect*, which is not *Formally* or *Eminently* contain'd in its Cause. A thing is said to be *Formally* in its Cause, when it is such there as we perceive; but *Eminently*, when the Cause can supply its stead. Thus *Fire*, when it produceth heat in a *Body*, is said to contain it *formally*, because it hath the very same thing in it self, which it hath produc'd in the *Body*; but the *Sun* and the *Earth*, when they produce *Fruits*, do not comprehend the thing caused by them *Formally*, but *Eminently* only. This *Notion* is the First of all others, and is as evident, as that *Nothing* can be made out of *Nothing*: For should we admit that something is contained in the *Effect*, which is not contained in the Cause, we must own that *Something* may proceed from *Nothing*. Neither can we give any other Reason, why *Nothing* cannot be the Cause of any thing, but because in it there cannot be found what is in the *Effect*.

Wherefore we conclude from the *Idea* we have of *God*, that he exists; which is, *First*, thus demonstrated: Every thing represented by an *Idea* must have a Cause, in which it is either *Formally* or *Eminently* contained; but we have an *Idea* of *God*, as he is a *Most perfect Substance*, excluding all Limitations: Therefore this *Idea* must have *GOD* for its Cause. The *Minor* is thus proved: There is nothing found in all *Created Beings* that can afford us this *Idea*: For tho' I can form the *Idea* of a *Substance*, because I my self am a *Substance*; yet will this *Idea* never represent an *Infinite Substance*, because I my self am *Finite* and of bounded Perfections; wherefore it is necessary that if I have an *Idea* of an *Infinite Substance*, it must proceed from *God* alone, who is *Infinite*.

XII. In what sense God is said to be the Creator of all things.

XIII. God may be known by us, tho' not comprehended.

XIV. A Objection fetch'd from the Divine Incomprehensibility.

XV. We may have an Idea of God, without comprehending of him.

XVI. The word Cogitation is Equivocal.

He is also owned to be the Creator of all things, because all things depend on Him, not only to their Being, but also with regard to their Conservation. For since Infinite Power is included in the Idea we have of God, it is a Contradiction, that any thing should Exist, which is not produced by him.

Under these Attributes it is; that God may be known by us: For we have a clear and distinct knowledge of God as he is. A Being Infinite, Omnipotent, Eternal, Omniscient, and the effective Principle of all things. And he may be thus defined by us: A Being thinking in Perfection (or most perfectly thinking) Simple, Unchangeable, Eternal, Consummate, Necessary, Immense, Incomprehensible, Omnipotent, and of which all things depend, not only with regard to their Nature and Existence, but also to their Order and Possibility. Neither is it any Contradiction to what hath been said of our knowing him, that he is declared to be Incomprehensible: For it is one thing to know a thing, and another to comprehend it: I own that we who are Finite cannot comprehend the Infinite Essence of God, since it is of the Nature of Infinity to be Incomprehensible: But it is no Contradiction to say, we may know that which is Infinite, that is, clearly and distinctly apprehend a thing to be such, that no bounds or limits can be found in it, or set to it.

You will oppose, That if the Weakness of Man cannot aspire to the comprehension of that which is Infinite, he will never be able to conceive the Notion of that which is so, but only of that which is Finite: For who will say that he sees a Man, when he sees only one Hair of his Head? Now there is less proportion between a Finite thing and an Infinite, than there is between one Hair of a Man's Head, and his whole Body.

I Answer, That it is not at all needful, in order to our having the Notion of an Infinite thing, that we should comprehend all its Perfections, this being sufficient if we find no bounds or limits in it; because then we understand the whole Infinite, tho' not Totally, as the Schools term it, and as to every one of its Parts. Who dare say that I have not the Idea of a Triangle, when a Figure comprehended within three Lines is represented to my Mind; tho' it may be I am ignorant, that its three Angles be equal to two right ones? And so in like manner I may have an Apprehension or Notion of God, without comprehending all his Attributes. For if it were otherwise, I should understand nothing at all, when mention is made of the Worship of God, his Works, Mercy, or Justice. For it is not of the Essence of an Image, that it be in all things the same with the thing it represents, but only that it be in some degree like it.

But yet we are to observe, that the word a Thinking-Being, or Substance, is Equivocal when attributed to God and the Creatures; because the Cogitation, which constitutes the Nature of God, is Independent and Perfect, and that which constitutes the Nature of a Created Spirit is Imperfect, and dependent of God: Wherefore to mark this difference, I say, that the Cogitation, which constitutes the Nature of God, subsists by it self; whereas that which constitutes the Nature of a Created Spirit, subsists indeed in it self, but not by it self.

I. What we are to understand by the word Idea.

II. What distinction there is betwixt Idea's.

III. Whatsoever is in the Effect, is formally or eminently in its Cause.

IV. From the Idea we have of God, we conclude that God is.

V.
An Obje-
ction an-
swer'd.

If you argue, that this *Idea* may be formed from the several Perfections scattered up and down in the several Parts of the *Universe*; after the same manner as from the Notion of an *Angel*, and my own *Mind*, I can frame an *Idea* of a *Divine Understanding*. I answer, How can I from the several Endowments of diverse Things, frame a *Being* that is absolutely Perfect? Shall I do it by enlarging and extending those *Images*? But whence have I the Faculty of enlarging all the Perfections of *Created Things*, and concerning something that far exceeds them all? We ought rather to conclude, that this is, because the *Idea* of a most Perfect *Being* is impress'd upon my *Mind*. Moreover, the supream Perfection of *God* consists in this, That all his Perfections are not separate, as in the *Creatures*, but in conjunction with the most absolute *Simplicity* and *Unity*.

VI.
No Idea of
an Infinite
Being is
contained
in the Idea
of a Finite
Being.

And tho' the *Idea* of an *Infinite Substance*, which most perfectly includes all the Perfections our *Mind* can conceive, may also contain the *Idea* of a *Finite Substance*, (as a *Multitude* contains an *Unity*, and a greater Number a lesser;) yet is not the *Idea* of an *Infinite Being*, contain'd in that of a *Finite Being*. And therefore *Des Cartes* in his *Third Meditation* says thus: *I manifestly understand, that there is more Reality in an Infinite Substance, than in a Finite; and therefore that the Perception of an Infinite Being, is in some sort precedent in me, to that of a Finite Being, that is, the Idea of GOD, to that of my Self. For how could I understand that I Doubt, that I Desire, that is, that I want something, and am not altogether Perfect, if there were not in me the Idea of a more Perfect Being, by comparing my Self with whom I discern my own Defects?*

VII.
That which
is Perfect
cannot pro-
ceed from
that which
is Imper-
fect.

Secondly, That which is perfect cannot proceed from that which is imperfect, as from its *Total* and *Efficient Cause*: But we, as all other *Creatures*, are Imperfect; and the Perfections which are in *God*, are neither *Formally* nor *Eminently* contained in us: So that the *Idea* of *GOD*, which contains all his Perfections, cannot be thought to proceed from us, and consequently *God* must be the *Cause* of it; and because He cannot be the *Cause* of it, except He do exist, we may undoubtedly conclude that He doth so.

VIII.
The Idea of
God is in-
born in us.

If any one ask, whence we have this *Idea*, since it doth not proceed from our *Senses*, nor from any *Created Being*? My Answer is, That it is born with us, as the *Idea* of our Selves also is: For *God* impress'd it upon every *Man* in his *Creation*, and hath so order'd it, that every one should understand and know *God* by the same Faculty whereby He knows himself. For it is impossible that any one should understand himself to be imperfect, depending on another, and of uncertain Duration; but that at the same time he must also understand Him, with whom compared, he is imperfect, and on whom he depends; so that reflecting upon himself, he concludes that *God* is, and by the *Idea* which he hath of him, is convinc'd of his *Existence*. I say, by reflecting on himself; for by the impression made upon us by *God*, we are not to understand that this *Idea* is always actually represented to us; for were it so, we should always think of *God*: But by this *Impression* is meant nothing else, but that *God* hath vouchsafed

such a Faculty to *Man*, whereby he can excite this *Idea* in himself, without the help of any other *Idea's* whatsoever.

It cannot be said, That this *Idea* is framed or invented by us, as many *Notions* are, which have no other *Existence*, but what they have in our *Understanding*; because nothing can be added or taken away from this *Idea*, for the *Essences* of things are indivisible: So that if any Thing could be added to any *Idea*, representing the Nature of a Thing, it would be no more the same, but another *Idea*. And tho' new Perfections may still be perceived in *God*, which were not known before; yet doth not this change the *Idea* of *God*, but only makes it the more clear and distinct; no more than the *Idea* of *Man* is increased, when some new Properties are discover'd in him, which before were unknown, because they ought to have been included in the *Idea* which we had of him before.

But you will farther urge, That *Man* who has this *Idea* is a free Agent, and that consequently he can frame the same at pleasure. And *Des Cartes* seems to hint as much in the *Beginning* of his *Fifth Meditation*, where after he hath said, That innumerable *Idea's* of Things are found in his *Mind*, adds, Which tho' they be in some sort thought by me at pleasure. Now if we can think of Objects according to our pleasure, why may we not say, that the *Idea* of *God* is framed by us, whilst we are thinking of it?

I Answer, That *Idea's* do indeed depend on us, as far as they have a *formal* and *proper Being* in our *Mind*; but not as they are considered in their *objective Being*; because in that respect they have a necessary *Cause*. I own it to be in our power, to think, or not to think of any particular Object, and that we are thus free by a liberty of *Contradiction*, or by a liberty as to the *Exercise* of the *Act*, as the *Schools* express it; but that it is not in our power, to think differently of the same thing that is true, that is, we have no liberty of *Contrariety*, and as to the *Specification* of the *Act*. For it doth not depend on our *Will* to think the Number *Nine* to consist of three *Ternaries*, and not to consist, or to be an *Even* or *Uneven Number*, &c. Neither can we conceive a *Substance* absolutely perfect, as *Existing* or not *Existing*, *Wise* or *Ignorant*, *Merciful* or *Cruel*; but must necessarily conceive him necessarily *Existing*, *All-wise*, and *All good*. Wherefore when *Des Cartes* saith, That many *Idea's* are found in him, which it may be have no *Existence*, besides his *Cogitation*, he presently subjoins; yet are they not feigned or invented by me, but have their true and unchangeable Natures.

Neither doth it contradict our Assertion, what some say, That we have deriv'd all the Knowledge we have from our *Parents*; who having receiv'd the same from the first *Men*, afterwards communicated the same to us, and that consequently the *Idea* we have of *GOD* is not in-born, seeing that this Objection seems rather to confirm the *Idea* of *GOD* to be in-born in us: For let us ask them, from whom those first *Men* had this *Idea*; if from themselves, why may not we have it as well? If from *GOD* revealing the same to them, then they must own *GOD* to Exist.

IX.
The Idea of
God cannot
be said to
be invented
by us.

X.
An Object-
ion to prove,
that the
Idea of
God is
framed by
us.

XI.
Many things co-
cur to our
Thoughts,
which tho'
they do not
Exist, yet
have their
Nature.

XII.
The Idea
we have of
God, is not
derived
from our
Parents.

CHAP. III.

That it belongs to the Nature of God to Exist.

I.
Whether
Existence
doth apper-
tain to God.

I Have evidently enough, as I suppose, Demonstrated in the foregoing Chapter, that because I find in my self the Idea of a Being absolutely Perfect, therefore that Being must Exist. Now I proceed to shew whether the Existence of God, can be proved from the consideration of his Nature, and whether a Possible only, or a Necessary Existence do belong to him.

II.
The Ex-
istence of
any thing
may be en-
quired into
after a
two-fold
manner.

Two Questions may be formed of a thing that Exists in Nature, the one with respect to our Knowledge, the other with respect to the Thing considered in it self. By the First, the Reason is sought, why any thing, suppose God or the Soul, is affirmed by us to Exist: By the Second we enquire, how it comes to pass, that the said thing is not only Possible, but really Existent. By either of these ways we may enquire after the Existence of God, for we have Reasons that not only assure us that God Exists, but also that this his Existence is necessary.

III.
The Idea of
an Infinite
Being prove
its Ex-
istence.

Neither will it be hard to Demonstrate this, if we attend to the Idea we have of God, viz. that he is Infinite, all Powerful and all Perfect: For we argue thus: Whatsoever we clearly and distinctly perceive to belong to the Essence of any Thing, the same we know to be true as we perceive it; but we clearly and distinctly understand, that it belongs to the Essence of God that he Exists; therefore it is true that God Exists. The Minor is thus proved; It is a contradiction for a most perfect Being, to want any Perfection; but Existence is a Perfection; therefore God cannot be conceived, but Existent. For since where a Multitude is, there must needs also be a Unity; therefore since God possesseth all Perfections conceivable, he must of necessity also have Existence.

IV.
The Ex-
istence of
God is ne-
cessary.

Neither doth it oppose the Truth of what hath been said, that in all other Created Beings, the Essence is distinguished from their Existence; and that it doth not follow, that a thing doth exist because we have a Notion of it. For the Reason thereof is, because in the Idea of all other Things only Possible, and not actual Existence is contained, whereas the Nature of God includes actual, necessary and Eternal Existence: So that it is as impossible for us to conceive a Hill without a Valley, as to conceive an absolutely perfect Being, to whom any Perfection is wanting, or who is not Existent: For as Cogitation supposeth the Existence of a thing Thinking, for if it had no Being, it could not Think: So absolute Perfection presupposeth necessary Existence, since nothing can be conceived absolutely perfect, except it Exist.

V.
Existence
is a Per-
fection
without
which the
nature of
God cannot
be concei-
ved.

Wherefore in this point, we differ from Gassendus, who denieth Existence to be a Perfection, or the Propriety of any thing, but that which adds neither Perfection nor Imperfection to a thing. Because when we attend to the Notion of God, we perceive, that Existence is a Divine Property, and no less belongs to God than Omnipotence or Immensity, &c. or that an equality of Angles belongs to two Right ones. Because it belongs to the Nature of God to be; neither can he be conceived without Existence. For would not something be wanting in God, in case he did not Exist? Or how otherwise could he be said to be a Being absolutely per-

fect? Since Existence is nothing else but the Reality of any thing, whereby it is placed out of Nothing, which therefore no Being absolutely perfect, can be supposed to be without. For as Cogitation presupposeth the Existence of the thing that Thinks; so likewise, absolute Perfection requires Existence; because an absolutely perfect Substance cannot be conceived, but as actually Existent, and unchangeable from Eternity.

You will say: Tho' we cannot conceive a Mountain without a Valley, yet it doth not follow thence, that there is any Mountain in Nature, since a Mountain doth not include Existence: And therefore neither doth it follow that God Exists, because I conceive him as Existent. For there is no necessity laid upon things to Exist, from my Thought or Apprehension.

VI.
Objections.

I Answer, That this Argument doth not proceed aright; for tho' a Valley enters the Conception of an Hill, and neither can be apprehended without the other, yet is it not inferred thence, that either a Mountain or Valley doth Exist; but that whether they Exist or do not Exist, they cannot be separated from each other. But seeing I cannot conceive God without Existence, I must conclude, that Existence is inseparable from him, and that therefore God cannot be conceived, but as Existing.

VII.
Answered.

But you will further urge, that the Sun Existing doth essentially involve two things, viz. the Sun and the form of Existence, so that Existence belongs to this complex Notion of the Sun Existing. But Gods knowing this complex Notion from Eternity, doth not impose a necessity of Existing upon the Sun, without presupposing its actual Existence in the World. So likewise tho' Existence be contained in a Being absolutely perfect, yet cannot we conclude thence that it actually Exists, except we suppose it to include Existence, as well as the other Perfections.

VIII.
An instance
urged a-
gainst this
Answer.

I Answer, That in the Idea of an Existing Sun there is only a Possible, but not a necessary Existence contained; because we do not understand that actual Existence must of necessity be joyned with the Properties of the Sun; for tho' it be conceived as Existing, yet doth it not follow thence that it doth Exist; forasmuch as this complex Notion, the Existing Sun, may be framed by the Understanding; and that these two Notions may be separated, not only by Abstraction, but also by a clear and distinct Operation, so as that the Sun may be conceived without Existence. Whereas, in the Idea of God actual and necessary Existence is involved, which hath an inseparable Connexion with the rest of his Attributes. So that it is impossible to conceive an Infinite Being to have all Perfections, except it do actually Exist. For necessary Existence is the Property of God, which agrees to him alone, and makes a part of his Essence.

IX.
The instance
Answered.

Wherefore, when we enquire, whether the Existence of a thing absolutely perfect can be inferred from its Idea, the Question is not, whether out of every Conception or Idea of a thing, we can Demonstrate its Existence; but only whether from the Idea we have in our Mind of a Being absolutely perfect, we may rightly conclude its Existence. For it is a Fallacy, when we bestow an Attribute, that agrees only to one Subject, upon all. Wherefore I do rightly and demonstratively conclude, that if necessary Existence be contained in the Idea

X.
The Idea
of every
thing doth
not argue
actual Ex-
istence.

of

of God, that is, if by a clear and distinct Perception, I cannot divide actual Existence from his Nature, God must necessarily Exist; by the same necessity that the Nature of Man doth consist of Soul and Body, and that a Valley includes the Conception of an Hill.

XI.
The Essence
of God is
not a Fig-
ment of our
Understand-
ing.

Some with whom I have Discoursed about this Point, deny the Essence of God to subsist any where but in our Mind, and that it is nothing else, but a figment or thing feigned by the Understanding. But this is easily overthrown by shewing, that necessary Existence is not included in any Fiction of our Understanding. Besides, the Essence of God is either Possible, or Impossible; if they grant the first, it must necessarily Exist; for what other thing can impart Existence to a thing that is Possible? If they say it is Impossible, it will lye upon them to prove the Contradiction it implies.

XII.
The Ex-
istence of
God may
be proved
from the
Conser-
vation of us.

The Existence of God may also be proved from our continued Preservation. For seeing that a Creature hath no power to preserve it self, we must have recourse to some Cause that preserves it. Time we know is divided into many Parts, which are independent of one another; since a Thing under Duration, may every particular Moment cease to be; neither doth it follow, because it was yesterday, that it must be to day; wherefore there must be some Cause to preserve it, and as it were to produce it anew every Moment, which its self cannot do, no more than it could at first give its self a Being. For Conservation is not distinguishable from Creation, but only by Reason; neither is there any less power required to Conserve a thing, than to produce it: Neither can Parents do this, since they only procure some Dispositions in the Matter, to prepare it for the Reception of the Soul, and we may Live after they are Dead: Wherefore there must of necessity be some first Cause, which may not only create and produce us, but also keep and preserve us.

XIII.
How it is
to be under-
stood that
things can-
not preserve
themselves.

If you oppose to what I have here alledged, the Law of Nature set down by Des Cartes: That every thing, as far as in it lies, endeavours to continue in the same State, neither is ever changed, except it be forced to it by a foreign Agent; and that according to this Law, every thing which Exists, must continue always to Exist, neither stands in need of any new force, whereby to be sustained in its Essence. I Answer, That whatsoever is besides God, is a Being depending on another; and whatsoever once essentially depends on another, must of necessity, for always so depend on it, because what is Essential admits of no change; and so great a Virtue is required in an Independent Being, that all things depend on it, as in the First Moment, so also in the Second, Third, &c. Wherefore when it is said, that every thing, as much as in it lies, continues in the same State; this must be understood with regard to the Perfection or Nature which hath been given to it, to which God who is constant and unchangeable, is supposed to afford his continual concurrence.

XIV.
An account
of what is
to be hand-
led in the
following
Chapter.

Tho from the Idea we have of God, and from the Contemplation of him, and our own Conservation, his actual Existence is evidently deducible; nevertheless we will also endeavour to make out the same from all Sensible Objects. This was not undertaken by Des Cartes, forasmuch as he being chiefly intent on the Idea of God, had not yet disco-

vered Material things, and therefore could not properly, alledge any Argument from their Production.

CHAP. IV.

The Contemplation of the World proves the Existence of God.

Almost all the Philosophers that ever duly considered the Miracles of Nature, constantly acknowledged an Eternal Godhead, by whose out-breathing all things are Quickned, and receive Life and Heat. For who is there so stupid, who from the Stupendous Structure of the World, the continual Rotations of the Heavens, and the never discomposed order of Nature, doth not necessarily infer, that there is a Supreme Creator, who doth govern the World, as Boethius saith, by Perpetual Reason, at whose command Time is, and who being Stable, and Immoveable himself, imparts Motion to all things? What else doth the vast extent of this World, the variety of things therein contained, the Beauty of its Parts, the constancy of its Motions Preach to us, than that there is a great Moderator, who is the Author of this Transcendent Structure, and the Original disposer of this Harmonious Order?

We all are link'd to God, a silent Breast,

His Temple is. ———

What is the Place of God but Heaven and Earth

The Air and Seas, to which he's given Birth?

What but a Vertuous raised holy Mind?

Where if we can't, we'll scarce him elsewhere find.

All that thy Gazing Eye doth see, and all

That doth thee move, is that which God we call.

Lucan. lib. 9.

I will own that some mean Philosophers, may rest in the Contemplation of Second Causes, and entertain their Minds with the consideration of Natural Objects, without looking further. But it is impossible, that he who attentively considers their Subordination, and diligently weighs their Connection, should not be forced to own a Creator of Heaven and Earth, and acknowledge his perpetual Providence, except (as Aristotle saith) he be so unhappy, as to be fallen into the deepest Gulf of Blindness and Misery. But that we may illustrate this a little by an Example, Let us suppose that Protagoras, or some other Atheist, had got a view of Archimedes his Glassy Sphear, in which the Heavens, I say, perform their several Motions, where the Sun and Moon do by degrees withdraw themselves towards the East, and being hurried along by the Primum Mobile, are whirled about, within the space of Twenty four hours; Do you think that Protagoras would have believed this Machine, to have been jumbled together by Chance, by a Fortuitous Concurrence of the Parts, and not much rather that it was the effect of Art, and of the Brain of a most Subtil and Accomplisht Mathematician? For seeing it doth chiefly belong to an Intellectual Agent, fitly to adapt divers things, and to dispose them according to his designed end, he will be forced to confess that such an accurate and ingenious

I.
The first
Argument
for the Ex-
istence of a
God from
the Fabrick
of the
World.

II.
Order sup-
poseth an
understand-
ing arti-
ficer.

III.
Never were
any Mira-
cles wrought
for the Con-
viction of
Atheists.

genious piece of Work, must have proceeded from Reason, and not from a Chance-medley of Atoms.

But if it be lawful to compare Great things with Little, and Weak things with such as are Perfect, what is Archimedes his Sphear in comparison to this Universe? How much more Perfect is the Original, than the Copy? And shall we believe that Archimedes, in his Imitation of the Motion of the Wandring Stars, made use of Reason, and at the same time suppose, that this infinite number of Stars, this wonderful adorning of the Heavens, this excellent Order of an unutterable variety of Works were the product of casually jumbled and justled Atoms? This can never be supposed by any one in his right Wits: And he that hath either outward Eyes to see with, or an Understanding to discern, can never submit to what is so contradictory to Sense and Reason. For this cause I suppose it is, that GOD who disposeth all things in Number, Weight, and Measure, and who takes so great Care for Mankind, yet hath never been known to work any Miracles in favour of Atheists; because the Workmanship of Nature is not only a convincing Argument of his Power, but doth also strongly invite and persuade us to the highest Admiration of all his Divine Perfections. And to speak the truth, I could much more easily believe all the Fables of AEsop for true Histories, and that Mice had conferences together, and that a Weasel entertain'd a witty Discourse with the Fox, than that the Rising and Setting of the Stars, the Vicissitudes of Day and Night, the variety of Seasons in the Fourfold divided Year, the two Equinoxials, and as many Solstices, could ever have been so ordered, without the Divine, that is, the most Perfect Reason; or preserv'd in the same, by an invariable and uninterrupted Succession. For do not all these, and all the other Wonders, with a constant and never ceasing Voice seem to proclaim, that they are the Off-spring of an Invisible Sovereign Power, and by no means their own Artificers? He hath made us, and not we our selves.

IV.
The vari-
ous Species
of Animals
prove the
Being of a
GOD.

But that I may not insist too long in laying open the Beauty of the Universe, I will pass by the vast Globe of the Earth, poised in the midst of the Air, the Mountains lifting up their Heads towards Heaven, the Rivers that water and fructify the Earth, the prodigious variety of Vegetables, which grow of themselves, and the vast number of Mines and Quarries, from which Gold, Silver, and the rest of the Metals, with several sorts of Earths and Stones are dug. Let us only consider, the almost infinite differing kinds of Living Creatures, whose opposit outward shape, and the great and many Conveniences and Necessaries they afford to Mankind, declare them to be the effect of the One only First Principle or Author of all things. For who can imagin that the difference of Male and Female, the desire of Mutual Embraces, and of perpetuating themselves by their Posterity, and Organs fitted for that purpose, were design'd and contriv'd by any thing less than a Wise Omnipotence? Who is there, that upon a diligent view of the several sorts of Birds, their astonishing Artifice in making their Nests, their Hatching and care of Feeding their Young, their dexterity in teaching them to Fly, doth not

presently discover the Supreme Cause of them, who with wonderful Wisdom and Artifice hath contriv'd and order'd all things, and hath imparted several virtues and forces to different Animals, according to their various use and capacity? How exquisitely is their whole frame suited to the use for which they are design'd, and how accurately are their Organs adapted to their several Actions? Thus Bulls are furnish'd with Horns; Lions with their Paws; Elephants with their Teeth and Snout; and the Rhinoceros with his close Armour, as well in order to the attaining of their designed End, as to defend themselves, and offend their Enemies.

Shall any one be so weak as to think, that broad and flat Feet were given to Water Fowl without any design, and by meer hap-hazard, when the use of them in Swimming is so apparent? Can any one suppose that Hens, should by chance, have long Legs and Necks, and Beaks sharp-pointed like Daggers, wherewith they pierce the Fishes, and draw them out of the Water for their prey? Whence hath the Pike his prominent Saw-like Teeth on each side his Jaws, and the Roof of his Mouth thick set with Hooks, that the slippery Prey might not escape his greedy Jaws? Is it by chance that the Woodpecker is furnish'd with Claws, wherewith it runs up the side of Trees like a Cat, and a forked Tongue, wherewith it robs the Tarantula of her Prey? Consider the Arts and Industry of the Bees, Pismires, and other Beasts, about their Food, begetting of their Kind, breeding of their Young, and fighting with their Enemies, and it will appear self-evident, that none of these can be supposed the fruit of an Accidental and Confused motion of Atoms, forasmuch as nothing more excellent, more apposit or useful, can be conceived by the Mind of Man.

But to make no longer stop here, let us take a view of Man, Nature's Masterpiece, and behold all the Excellencies dispers'd up and down in all other Living Creatures, united in this Microcosm, or Little World. Can any one behold his comely Form, the erect posture of his Body, his Face looking upwards, and (as it were) directed towards Heaven, and the Beautiful symmetry and proportion of his whole Body and Parts, and suppose him to have had no Author of his Being? But to leave the Wonders of his Outside, if we proceed to take a view of his Inward Parts, their structure and situation, the Nerves and Sinews deriving their Original from the Brain, the Arteries from the Heart, the Ethereal ever-moving Spirit that fills them, and imparts motion to all the several Joints and Members of the Body, and vigour and strength to perform all manner of Actions, we shall find still stronger Arguments to persuade us, that there must be a First Cause, who is the Principle of all Human Perfection.

But forasmuch as Vulgar Wits are more apt to be taken with Examples than Discourse, let us take to task some one Part of the Body of Man; for Example, the Eye, and scan the Miracles it contains. And here at first sight we meet with so many Wonders in its most curious Make and Contrivance, that it is impossible for a Man, not wholly bereft of Reason and Understanding, to doubt of the Sovereign Perfection of the Artificer. In running over its outward Parts, we meet with the

V.
The vari-
ous Facul-
ties in
Beasts,
plainly
prove a
Sovereign
or Supreme
Power, or-
dering and
designing
all things.

VI.
The behold-
ing of Man,
leads us to
the know-
ledge of a
GOD.

VII.
The descri-
ption of the
Eye, as to
its Exter-
nal parts.

Bony

Bony Orbit, or round *Ossea Orbita*, together with the *Eyelids*, the *Hair* of the *Eyelids*, and the *Eyebrows*, as also the *Glandules* or *Kernels*, with the *Excretory Vessels* and *Passages*, all which serve either to defend that tender Part, or assist and facilitate its *motion*. The *Eyelids* are as *Curtains* to the *Eyes*, and are assisted with the ministry of several *Nerves*, which by insertion into the *Muscles*, become useful for the opening or shutting of them. The *Eyebrows* and *Hair* on the *Eyelids*, are like *Ramparts*, to secure the *Eye* from things that are hurtful to it, and to prevent their sudden and unexpected eruption. The *Excretory Passages* serve to carry off the superabounding *Humor*, that the *Eye* may not be clog'd by the affluence of *serous Matter*, or the *Eyesight* dimmed by the acrimony thereof.

VIII.
The inward Parts
of the Eye
consider'd.

If we proceed to the *Inner Parts*, which Nature hath hid from, but Anatomy lays open to us; we shall first find the *Muscles*, wherewith this miraculous little *Globe* continues hung up and equally pois'd within the *Orbit*, and performs its various *motions*. In the Midst of it is the *Pupilla*, or *Sight*, of a round *Figure*, that the visible *Species* or *Rays* proceeding from *Objects*, might be the better received by it, from what part soever of the *Hemisphere* they come. After these appear the *Coats*, or *Membrans* of the *Eye*, and next the *Humors*, which like a *Dioptrick-Glass* do refract and center the *Rays* that represent the Images of *Bodies*. For the *Watry Humor* distending the *Membran*, and making it gibbous, doth amplify the *Convexity* of the *Eye*: And the *CrySTALLINE Humor* placed within the opening of the *Grape-like Coat*, *Tunica Uvea*, like a piece of *Glass* set opposite to a *Hole*, in which the *Rays* coming from all parts are collected and refracted. And behind the *CrySTALLINE Humor* is placed the *Glassy Humor*, by means whereof the *Tunica Retina*, or *Network Membrane* is at a fit distance separated from the *CrySTALLINE Humor*, so that when the *Rays* with due refraction have pass'd the same, they attain their proper place and center.

IX.
The structure of
the Ear
examin'd.

Tho' the *EAR* be not of equal use and concern to the convenience and necessities of *Life*, as the *Eye*, and is only design'd for the perceiving of *Sounds*; yet is it for the Excellence of its structure very little inferiour to that of the *Eye*, especially if we consider its *Inner parts*, and the mutual connexion of them. For from the *Lappet of the Ear*, which is narrowed by degrees, we see that the *Hollow of the Ear* goes slanting inwards, to the end that the *Sounds*, by passing its crooked Windings and Turnings, might be encreased. For the thin *Membrane*, placed near the *Hole* of this inward Cavity, being struck by the impuls'd *Air*, doth affect the *Fibres* and *Auditory Nerve* with the same motion. There are also three small *Bones* fitly disposed and tied together with a *Ligament*: The first of these is call'd the *Hammer*, because of the resemblance it bears with that Instrument; the second is call'd the *Anvil*, which is somewhat roundish; and the third, the *Stapes* or *Stirrop*; they are moveable, and seem to be of good use to defend the *Drum* of the *Ear*, and prevent its being too much slackened, or too stiff bent. From the fore-mention'd *Hollow of the Ear*, the Passage (commonly called by *Anatomists* the *Oval Hole*, or *Window*) opens into the *Labyrinth*, and so leads

to the last *Inner Cavity*, called *Cochlea*; because in its *Spiral Windings* it resembles a *Snail's Shell*, which if well view'd, appears to be the work of admirable Artifice; for being form'd with such Turnings, it renders the *Sounds* more distinct, and causes that there be no confusion of them. Besides, there are many other *Parts* not here to be insisted on, whose wonderful Contrivance does much conduce to *Hearing*.

Now who can be conceived so stupid and void of all *Judgment*, as to think that the *Organs* of these two *Senses* were made by a fortuitous jumbling together of small *Bodies*; and not rather acknowledge the most *High God*, who by his inimitable *Wisdom* has so curiously framed, and orderly disposed all these several *Parts*, that nothing can be imagin'd more adapt, and better suited to the uses for which they were designed.

I could never approve of *Democritus* his Opinion, which attributes the Original of the *World* to a company of jostling *Atoms*, as if their Roaming vagaries were an adequate Cause to produce all the *Bodies* in the *Universe*. For how can we suppose, that in that infinite Space, wherein he asserts his *Atoms* to be toss'd, they should come together and unite, to the framing of all the *Parts* of *Living Creatures*? Can we imagine, that by the huddling concourse of like *Bodies* so many *Nerves* and *Muscles*, so many *Ligaments* and *Tendons*, so many *Filaments* and *Fibres*, could be formed? Can we think that the *Legs*, *Shins*, *Feet*, *Toes*, *Joints*, with all the other *Organs* of the *Body*, were the effect of blind and impotent *Chance*? Can we conceive that the *Heart*, that Noble *Muscle*, and the *Breast* in which it is contain'd, together with its *Ribs*, *Muscles*, the *Lungs*, and the *Midriff*, were made without a Cause and at Hap-hazard? Or that such a vast number of *Veins*, *Arteries*, *Gristles*, and *Membrans* had no other rise, but meer *Chance* and the Heaviness of *Bodies*? Who can force himself to imagine, that an infinite number of *Blind Men* plac'd in an open Field, by a confused running in amongst one another, should at last produce an *Army* orderly drawn up in *Battle*, according to the most exact Rules of *Military Art* and *Discipline*? Or why may not we as well with *CICERO*, suppose that a vast number of *Alphabetical Characters*, being casually thrown upon the *Earth*, should all rank themselves into *Lines* and *Words*, making the *Annals* of *ENNIUS* the Poet? Now as no Man can so much over-bear his Reason as to think this possible, how much less will he be able to believe, that the curious Structure and Order of the *Parts* of *Animals*, is the effect of *Chance*, that is, of no Cause at all?

And to deduce this matter from the Beginning of the *World*; If it be so that *Atoms* have a Power to produce and generate things, why do they not now produce or renew the same Things they framed so long ago; why are there no *Mountains* raised anew? How is it that they do not constitute another *Sun*? How it comes to pass that all *Living Creatures* keep to their kinds, and that no new ones do arise from their Senseless jumbling together? Neither will it be of any advantage for the *Atheist* to alledge here, that *Flies*, *Mice*, and other *Insects* are daily generated without the Union of both *Sexes*; because the Question here is not concerning the Production of Things, but

X.
The structure of the
Eye and
Ear, cannot
be the
effect of a
Fortuitous
Concourse
of Atoms.

XI.
Living
Creatures
could never
be by
Chance.

XII.
Atoms cannot
produce
any thing
of themselves.

concerning the inborn Power of Nature, or *Seeds*, out of which *Living Creatures* are Born, and are endowed with a Virtue fit for the *Generating* of them. And seeing they have not this of themselves, since it is a contradiction for a thing to be productive of it self, it must follow that they are the effect of the *All-wise God*, by whose power they act whatsoever they do.

CHAP. V.

Concerning Fate and Will, or the Divine Decree.

I.
The Ancients took great Pains to reconcile the Divine Preordination with the Liberty of Mans Will.

THe *Ancients* were so solicitous of Preserving *Human Liberty*, that when they found they could not reconcile them with some of the *Divine Attributes*, they chose rather to acknowledge their own Ignorance, than to deny it. For when they found that all our *Actions* must be pre-ordained by *God*, forasmuch as he is the *All-knowing Governour* of the World; and on the other hand experienced in themselves a *Freedom of Will*, they admitted both to be *True*, viz. that *God* doth pre-ordain all our *Actions*, and that we nevertheless enjoy *Liberty of Will*. But when they afterwards proceeded to enquire further, how it could be, that *Mans Liberty* standing, *God* could have fore-ordained all things from *Eternity*, they ingenuously profest their Ignorance, and that it was no wonder, that an *Infinite Being* could not be Comprehended by a *Created Understanding*. This acknowledgment of *Human Frailty* was certainly praise-worthy in them: But forasmuch as all are not satisfied with this Answer, many being solicitous to know how the *Liberty of Man* may be reconciled with *Gods Decree*, I suppose it will not be useless to make out, that *Gods Foreknowledge* of and *Foreordination* of *Human actions*, doth not take away the *Liberty* of them.

II.
What Fate or the Divine Decree is.

And here if we consider the *Nature of Fate*, or the *Divine Decree*, we shall find it to be nothing else, but what *God* hath determined concerning every one of us: Or it is the *Eternal Decree* of his *Providence*, by which he *Sees, Knows* and *Governs* all things. And as *BOETHIUS* expresses it; *Fate is an Order or Disposition, Inherent in changeable things, by which Providence links them to their due Ranks and Orders.*

III.
Fate lays no necessity upon Human Actions.

Now that this *Order or Disposal* doth impose no necessity upon *Human Actions*, is apparent, because we find that it is in our *Power*, to give our *Assent* to, or to *Dissent* from many things, and after having ballanced both parts, to choose one, and reject the other. We see likewise that *Men* frequently change their *Minds* at the *Persuasions* of their *Friends*, and do refuse what first they had embraced. And indeed were it otherwise, all *Prudence* and *Reason* in *Mens* ordering of their affairs would be taken away; for if they had no *Freedom* to chuse that part, to which they are inclined by *Rational motives*; they would not act by the direction of *Wisdom*, but by *Chance* and *Fortune*.

IV.
It is an Argument of our weakness, that we cannot reconcile Gods omnipotence, with the liberty of our will.

And what can be more absurd than to go about to deny our *Liberty*, which we experience in our selves, and whereof we are so fully *Conscious*, that nothing can be more illustrious by the *Light of Nature* than it is, because we can scarcely reconcile it, with the *Divine Omnipotence* and *Providence*? We ought ever to remember that we are *Finite*, and that *God* is *Infinite*; and that our *Li-*

erty must not presently be denied, because we cannot conceive it inconsistent with the *Will* of *God*, which is without us, and which our *Minds* are not able to comprehend; forasmuch as this only proceeds from the weakness of our *Wisdom* and *Understanding*.

'Tis true indeed that *Fate* is immoveable, but yet so as that it inheres in things that are moveable; because it doth not take away the *Nature* or *inbred Motions* of things, but moves them sweetly and without any manner of constraint; according to the *Requirings* of the different *Nature of things*, so as to act *necessarily*, with things necessary, and *freely* with free and voluntary *Agents*.

Neither is this Assertion overthrown by that common Objection: If *God* foresees that I shall Sin, seeing that his *Foresight* cannot be deceived, it follows that I must necessarily Sin. For *God* doth not foresee my *Sinning necessarily*, but *freely* and voluntarily; and his *Knowledge* imposeth no necessity upon my *Actions*, no more than my knowing that *Peter* will walk to morrow, doth lay a necessity upon him of doing so: Or than the knowledge I have of the *Suns* Existence in the *Heavens*, doth cause the *Sun* to be there.

For what can be more Childish than to think, that the *Foreknowledge* of *God*, which is altogether External to the thing known, should put a force upon the *Will* of *Man*? But you will say, *God* cannot be deceived. And what then? Consequently, you'll say, it was either true from *Eternity*, that you were to recover of this *Sickness*, or else false: Therefore it is in vain to make use of a *Physician*, since neither the necessity of *Fate*, nor *Eternal Truth* can ever be changed. This is worthily still'd by *CICERO* to be a lazy Question, because by the same Argument you may overthrow all *Human Actions*. But that *Gods Foreknowledge*, doth not import any necessity is evident from this; that a *Contingent thing* is of its own nature Indefinite, and of a doubtful event, tho' with respect to the *Divine Foreknowledge*, it be Definite and determined. *AMMONIUS* illustrates this by the Example of a *Globe*, resting on the Plain of the *Horizon*, the indifferency whereof as to Rest or Motion, doth well express the indifferency of our *Will*; but if this Plain be never so little inclined, then it must move of necessity: So likewise when the *Will* is inclined to any thing, this makes a kind of necessity, upon Supposition only, that the *Will* turned it self this way; or that *God* did foresee this inclination from *Eternity*.

You will say, *Gods Prescience* is most certain; therefore its Object cannot but come to pass; and that which cannot but come to pass, is therefore necessary: Therefore, *Gods Foreknowledge* imposeth a necessity on the *Will*. I Answer, by distinguishing the Consequent; I grant that the thing which is the Object of the *Divine Foreknowledge*, cannot but happen upon Supposition, that it is to happen so, from a necessity of Consequence; but I deny that it cannot but come to pass absolutely, and by a necessity of Antecedence.

There is a two-fold necessity, the one Antecedent, and that is that which is the Cause of the Action, which necessity the *Will* cannot resist: The other is Consequent, which is not the Cause of the Action, but doth presuppose it, and is consequent to it. And it is this latter only which is brought upon *Human affairs*, by the *Divine Prescience*.

Forasmuch

V.
The Decree of God doth suit it self and comport with things.

VI.
Gods Foreknowledge lays no necessity or force upon Mans will.

VII.
The knowledge of God being external to the thing known, cannot hinder its Liberty.

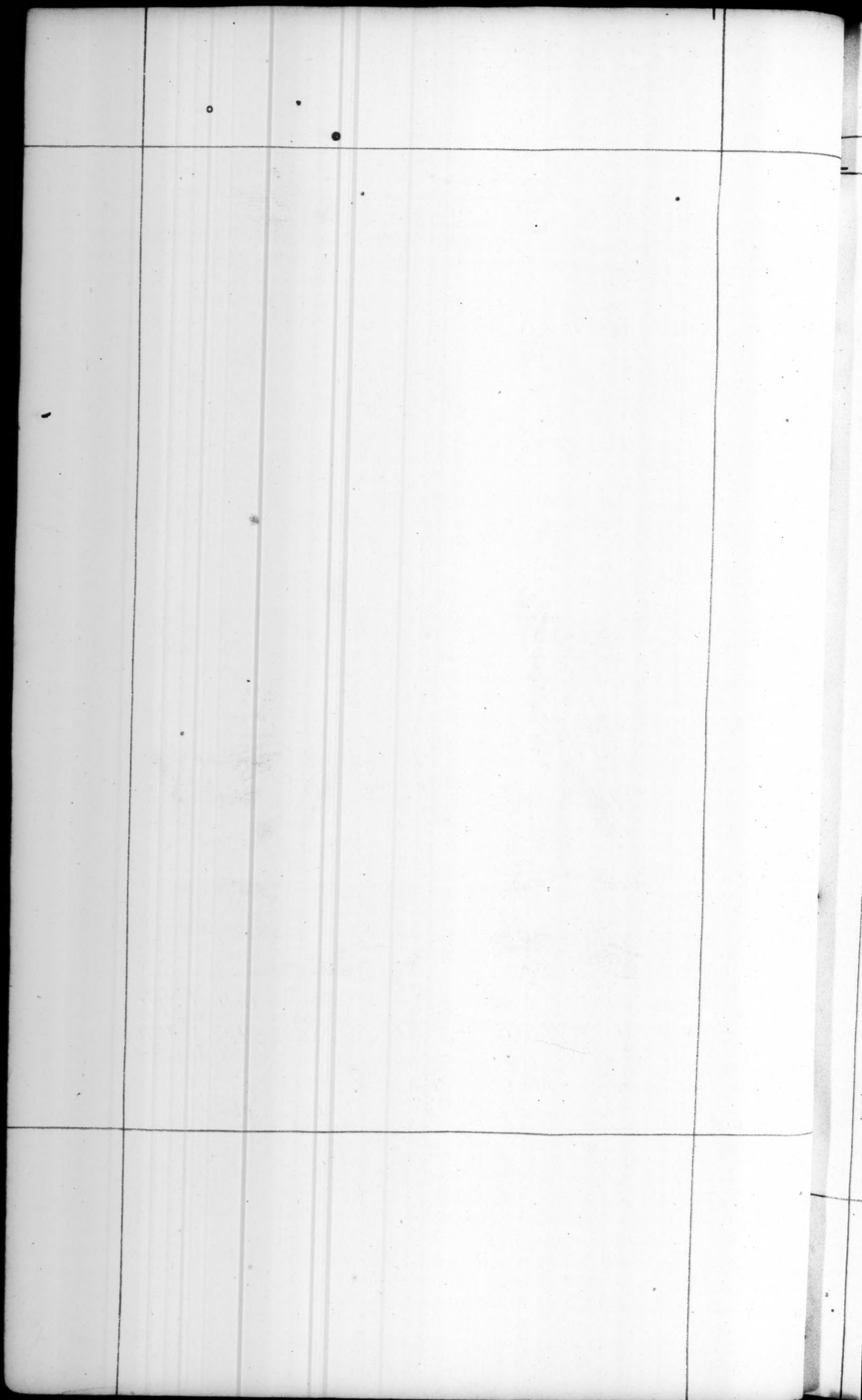
VIII.
The certainty of Gods Foreknowledge is no Argument for a force upon our will.

IX.
There is a two-fold necessity.



To the Wor- Shipfull Cap-
taine Richard Cheyney of Ham-
erton in the Parish of Hack-
ney in Middle- sex Esq^r.

This Plate is humbly Dedicated by Richard Blome.



Forasmuch as a futurity is not the Consequent of Gods Fore-knowledge, but his Prescience is the Consequent of that which is future; and in this Sense only it is, that the Object of Gods Prescience is called Infallible and Eternal.

C H A P. VI.

How God is said to be the Cause of Propositions of Eternal Truth.

I. How the Essences of things are distinguished from their Existency.

For the better understanding of this Question, we are briefly to presuppose, that the *Essences* of things are modally distinguished from their *Existency*: For we understand the *Essence* of a thing after one manner, when we abstract it from *Existence* or non *Existence*; and after another when we conceive it as *Existing*. For a thing is understood to be *Existent*, when it is without our Understanding: But a thing that doth not *Exist*, is objectively in our Understanding, and is not without our Thought. Of this kind are *Eternal Truths*, viz. That a Triangle hath three Angles equal to two right ones: Six and Four make Ten; and such like, which are considered as *Ideas* in our Mind. And forasmuch as these *Ideas* cannot be said to be nothing, but something, the Question is, what is the cause of them, that is, whether they depend on the Understanding of Man forming them, or whether they owe their production to some other Principle.

II. God is the cause of Propositions of Eternal Truth.

I Answer, that all *Eternal Truths* are from God, as from their efficient and total Cause; for he is the Cause of all *Creatures*, not only as to their *Existence*, but also with regard to their *Essence*. Forasmuch as he being *Infinite Goodness*, could not be impelled by any other Reason of *Goodness*, to do that which is best: But on the contrary because he determined himself to produce the things that are, therefore they deserve the Title of being *Good*. As for Example, he did not therefore will the three Angles of a Triangle to be equal to Two right ones, because he saw, that they could not be otherwise; but on the contrary, because according to his Free-will he had determined the three Angles to be necessarily equal to Two right ones, therefore they could not be otherwise. For in God to Will, to Understand and Create are one and the same thing: Wherefore because he knows a thing, therefore it is true.

III. The non-Existence of God being supposed nothing is less true.

Neither can we say, that these *Truths* would be no less true, whether God be supposed to *Exist* or not: For this is most false; because all *Truths* depend upon the *Existence* of God, who is the first *Eternal cause* of them, from whence they all flow as from their Fountain. Neither is this difficult to be conceived, if we consider God as an *Infinite, Eternal, Incomprehensible Being*, the Author of all *Good*, and on whom all things depend. And therefore they are in a great Error, who think that any thing can be independently of his *Will*.

IV. That twice four make eight is from God.

Neither doth it oppose what we have said, that the Mind of Man cannot conceive the three Angles of a Triangle not to be equal to two right ones; or that twice four should not make Eight: For to prove this, it is sufficient to shew, that there can be no Being which does not depend on God, and was not freely constituted by him: For this being laid down, it evidently follows, that it was not always necessary, that the three Angles of a Triangle

should be equal to two right ones, or that twice four should make eight, but that it was so constituted by God.

For seeing God is positively of himself, he is endowed with such an *Essence* and *Nature*, that from the consideration thereof we can assign a Reason for *Eternal Truth*, without need of having recourse to any other Object, for the clearing of their Evidence and certainty. This Attribute would agree to some other besides God, if we should suppose some *Natures, Truths* and *Essences* to be such as to be independent of God. Because if any one should demand why they were such, and whence they had their *Truth*, it might be answered, that they were *Eternally so of themselves*, and that for that Reason, they became the Objects of the *Divine Knowledge*, as being of themselves Antecedent to it. Which is so derogatory to the *Divine Omnipotence*, that it is a wonder to me how any can assert such a thing, who consider well the *Divine Independency* upon any things whatsoever. Forasmuch as it would follow from hence, that the Complement of the *Divine Cogitation* would not depend on the sole understanding of himself, but also of some other thing, which was not of the *Nature* of God, and which is conceived as independent on his *Will*.

If you Object that the *Essences* of things are *Eternal* and *Immutable*; I answer, That they are so indeed, if it be understood concerning the *Immutability* and *Eternity*, which God hath prefixt to them, whilst by his Free-will he has determined some things to be unchangeable. Or else it may be said according to the Sense of the Vulgar, that the *Natures* of things are *Eternal*, because there was no Time before them; or rather because the *Eternal God*, doth conceive them without Succession, neither will suffer them for ever to cease or be changed.

GOD therefore is the *Efficient Cause* of all things; not only of such as *Exist*, but also of *Possibles*, and of all *Truths* that we call *Eternal*: In like manner as a King is the Maker of all the *Laws* in his Kingdom. For all these *Truths* are inborn in us from him; as a King also would have them so in his Subjects, if he had Power enough to write his *Laws* in their Hearts.

If any one say, That this would make God inferiour to a King, who can at his Pleasure annul the *Laws* he has made; which if God should do, those *Truths* would lose their *Essence*, and consequently would be no longer *True* or *Immutable*.

I Answer, That the Case of God and a King are very different. A King can change his *Laws*, because his *Will* is changeable, but God's *Will* is unchangeable; for it is his *Perfection*, that he acts in a most constant and invariable manner. Neither doth it hinder this that his *Will* is free; for as his *Will* is free, so likewise is his *Power* Incomprehensible. Wherefore tho' I cannot comprehend how it should not be true, that One and Five are Six; yet I understand clearly enough, that it is impossible there should be any thing in the whole Universe of Things, which does not depend on him. And therefore it is contrary to Reason to think that any thing cannot be otherwise, because we cannot understand how it can be. It is indeed true in the general, that GOD can do all those things, which are clearly and distinctly known by us;

V. God being of himself there is nothing independent of him.

VI. In what Sense the Essences of things are said to be immutable and Eternal.

VII. God is the Cause of Truths, as a King is of his Laws.

VIII. Objection.

IX. Answer.

us; yet doth it not follow from thence, that he cannot do those things that we cannot conceive: For our *Imagination*, or *Understanding*, cannot be the Rule of his *Power*. Therefore we must conclude, That the *Essences* of Things, and *Mathematical Truths* are from *God*, because he so conceived them, so ordered, and so commanded them: According to that of *S. Austin*; *Because thou seest them, (or rather, because it listeth thee) therefore they are.*

CHAP. VII.

Concerning the Divine Attributes; and, First, Of the Unity of GOD.

I.
What the
Attributes
of GOD
are.

ALTHOUGH GOD be One meer *Cogitation*, and all his *Perfections* or *Attributes* indivisibly United; yet the Acts of *Cogitation* that we have of him, stirr'd up from several Occasions, which frequently involve many *Objects*, are Many. For when I consider, that my *Mind* doth not exist of it self, neither can do all, nor understand all things, &c. I turn my self to the *Divine Cogitation*, which comprehends all *Perfections*. And these *Reflexions*, whether as referr'd to *God*, or to the various Conceptions of *Objects*, are called *Attributes*. Whence it comes to pass, that one of my *Cogitations* I have of *God*, as *Existing*, is different from another *Cogitation* I have of him, as *All-powerful*, or *Eternal*: Because the occasions of these my Thoughts are different; and one *Object* which I refer or apply to *God*, is different from another which I can likewise apply to him. Wherefore seeing I do not find my *Mind* to be one only, but perceive also the *Idea's* of other *Minds* of the same Nature with mine, I cast my Eye on the *Divine Cogitation*, and thence take an occasion of considering its *Unity*.

II.
The Divine
Attributes
are indivi-
sibly united.

If therefore we consider the *Essence* of *God* in it self, it appears to us to be one *Simple*, *Uniform* *Cogitation*, exempt from all *Order*, *Distinction*, *Priority*, or *Posteriority*. Forasmuch as all the *Perfections* that are, or we can think of in *God*, are not only actually present in his *Nature*, and inseparably united with it; but are so intimately joyned, that the one is the other; yea, that one of them is all the rest, and All are most properly One in their *Essence*: So as that his *Eternity* is his *Omnipotence*, his *Life*, his *Spirituality*. In a word, All his *Attributes* are his *Life*, and his *Life* is all his *Attributes*.

III.
The Unity
of GOD
was known
to the An-
cients.

It was the constant Opinion of the *Ancients*, That GOD is One only, the Sovereign of the *Universe*, whom all things obey. Both *Poets* and *Philosophers* own'd this, who frequently call him, *The Maker of all things*, *The Ruler of the World*, and *The Mind diffus'd through all things*. Wherefore also they gave him no peculiar *Name*, as supposing that no *Title* could be given to him, who was singular, and had nothing common with other things; for that *Names* were only necessary where *Plurality* is to be distinguish'd, and persons discriminated by certain Marks.

IV.
The Divine
Unity is to
be explain-
ed.

But because the word *Unity* is taken in divers *Senses*, we are to enquire first, in what respect *God* is said to be one, before we can come to know, that there can be no more than one.

V.
A thing is

A Thing is said to be one, *First*, when its *Parts* are united; yet so as that it may be divided into

them; as a *Body* is said to be One, because of the *Union* of its *Parts*, tho' they be separable. Secondly, A Thing is said to be One, because it hath one *single Essence*, which cannot be divided into *Parts*; tho' the *Attributes* and *Modes* wherewith it is diversified, may be separated from it, such as *Knowledge* and *Vertue*, without which the *Soul* of *Man* may be. Thirdly, a Thing is said to be One, which is so undivided, that it can in no respect be divided, nor hath any *Attributes*, or *Modes*, that are separable from it, but all things appertaining are most simply one.

VI.
How God
is said to
be One.

In this last meaning *God* is said to be One, because all that is in him is One, neither hath he any *Attributes* that are not *Essential* to him, and Inseparable from him. And therefore according to our *Philosophy*, the *Divine Attributes* are only *Modes* of *Thinking*. For when we distinguish his *Will* and *Understanding*, that distinction is only made by our *Minds*, as we conceive him to be conversant about *Goodness* or *Truth*. But *Real Modes* are found in the Things themselves, which they affect and distinguish from others; as *Figure* and *Motion* in *Bodies*; *Willing* and *Understanding* in the *Mind*. And are therefore call'd the *Modes* of *Things*, because they agree to mutable Things, such as all *Created Beings* are; but not to a *Being* that is constant and ever-abiding, such as *God* alone is. Wherefore whatsoever is in *God* is only distinguishable by reason.

VII.
God is one
in such a
manner,
that there
can be no
more be-
sides him.

Having shewed what manner of *Unity* agrees to GOD, it may further be queried, Whether *God* be one in such a manner, as to suffer or admit none besides him. To which I answer, That *God* is One in such a manner that he cannot be multiplied: For seeing by the Name, GOD, we understand a most *Perfect Being*, it is necessary that it comprehend all that is most *Real*; so that supposing him to exist, all conceivable *Perfection* must be placed in him, so as by his *Idea* and *Essence* formally to exclude every most *perfect Being* besides himself. For indeed how can any be equal to him? Or how can all conceivable *Perfections* be in two several *Subsistences*; seeing that whatsoever admits of *Division* is subject to *dissolution*, which is the most remote from the *Nature* of *God*, who is *Incarnate* and *Eternal*.

VIII.
Multipli-
city of Gods
implies a
Contradi-
ction.

If it be said, That this *Division* is no hindrance to their *Immortality*, as long as the one doth not arrogate any thing that belongs to the other, but each of them follow their own work. It will still come to the same thing; for this distribution of their *Work* or *Business*, is an evident Instance of great *Imperfection*; because this supposeth them to stand in need of one another's assistance, being unable all alone to govern the *World*; which is contradictory to the *Divine Essence*, which is known to be *Omnipotent*, *Infinite*, and *All-wise*.

IX.
If there
were more
Gods than
one, they
could not
be equal.

Moreover it is most certain, that supposing a *Plurality* of *Gods*, they cannot be every way equal, but that some *Perfections* would be found in the one, which are not in the other, which is altogether incompatible to the *Supream Being*. For let us suppose two *Gods*, whom for the greater clearness of Discourse, we will call *Saturn* and *Jupiter*. Now these two *Gods*, forasmuch as they severally include all *Perfections*, they must of necessity be *All-knowing*, so as not only to know themselves, but others also; and because in the *Idea* of either

of them, necessary *Existence* is included, it will follow, that the Cause of the Necessity and Truth of the *Idea* of *Saturn*, which is in *Jupiter*, will be *Saturn* himself; and the Cause of the Truth and Necessity of the *Idea* of *Jupiter*, which is in *Saturn*, will be *Jupiter*; and therefore some Perfection will be found in *Saturn*, which is not in *Jupiter*; and in *Jupiter*, which is not in *Saturn*. The reason whereof is this, because the Perfection of the understanding of either of them, will depend on the other; and so must be both of them Imperfect, which is repugnant to the Nature of a most perfect Being.

It belongs also to the *Idea* of a most perfect Being, that he be *All-powerful* and *All-knowing*; but it is a Contradiction, that more Beings than one should be endowed with these Perfections: For either they would be able to hide their Thoughts from each other, or not be able; if the first, how could they both be *Omniscious*? If the latter, how could they both be *Omnipotent*?

Lastly, Necessary *Existence* is included in the *Idea* of *God*, because he is *Independent* of, and before all other Beings. Now whatsoever doth necessarily exist, must of necessity be Singular, since Singular Being is nothing, but actually to exist, which is so peculiar to *God*, that he cannot but exist: Wherefore seeing Singularity and Unity are one and the same thing, it is evident that the *Divine Nature* excludes all Multiplicity, that is, cannot be divided into more Gods; and consequently, as *God* is *Undivided* in himself, so neither can he be partible into others.

But may some say, How comes it to pass then that the *Heathens* worship'd many Gods, if it be so that more Gods than one implies a Contradiction? I answer, That the *Heathens* never had any *Idea* of many Beings absolutely perfect, as is evident from their Writings; because they made one to Rule in *Heaven*, another in *Hell*, a third over the *Winds*, a fourth over the *Fire*, and distributed the Government of the *Universe* amongst many Gods: But they did not suppose any of them to contain all manner of Perfections, and to have the Power and Dominion over all *Creatures*; but took them to be much of the same Nature as we conceive the *Angels*. And *Marsilius Ficinus* tells us as much, *Argument. in Cratylum*: Neither let it trouble you, saith he, that *Plato* doth frequently make mention of many Gods: For he proves in his *Parmenides* and *Timæus*, that there is but One *God*; and that the rest are only his Angelical and Heavenly Ministers; and by calling them Gods, doth not so much imply their being Gods, as their being Divine. For indeed the *Philosophers* do so much abhor a Plurality of Gods, that it would be more easie to persuade *Euclid*, that many Centers may be found in a Circle, than to make *Philosophers* believe that there are more than one *God* in the *World*.

CHAP. VIII.

That GOD is Eternal, or without Beginning and End.

THO' almost all *Philosophers* agree in this, that there is a *GOD*, and that he governs the *World*; yet don't all of them conceive his *Existence* after one and the same manner. Some of them are of Opinion, that *GOD* had some kind of

Beginning, and tho' the same were before all Ages; yet that he was born or produced as all other Things. But forasmuch as it was unbecoming the *Divine Majesty* to proceed from any other, and that he who is the *Author* of all Good, should derive his Being from another, they asserted him to be his own *Efficient Cause*, and that he so proceeded from himself.

But this Opinion does not so much oppose Reason, as it destroys the very Nature of *God*: For how could *God* produce himself, since this supposeth that before his Production he was not, because he was then to be produced, and yet was at the same time, forasmuch as he did then influence his own Production, which are absolute Contradictions. And whatever may be said in this case, we must allow some Principle of the *Divine Production*, which is absolutely repugnant to the Nature of *God*. For we no sooner consider the Nature of *GOD*, but we find him to be the Most perfect Being, which excludes all Imperfections, that is, any bounds or limitation of his Perfections, and includes all Perfections, and consequently also *Existence*, by which he is distinguish'd from all other things.

For tho' whatsoever we conceive be apprehended by us as Existing; yet we find that *Existence* doth not belong to *God* and the *Creatures* in the same manner. For in the Conception of *Creatures*, whose Perfections are finite, only Contingent and Possible *Existence* is contained; whereas in the Notion of *God*, Necessary *Existence* is included, as being an *Eternal Perfection*; insomuch that it is as obvious to our knowledge that *GOD* exists, as it is to a *Mathematician*, that a *Triangle* hath three Angles equal to two right ones. For as it is the Nature of a *Triangle* to have three Angles equal to two right ones; so likewise it is the Nature of *God*, to be necessarily Existing, and therefore as he exists now, it must be acknowledg'd that he hath existed from all *Eternity*.

They who do not mind this, are very liable to Error, and to ascribe to *God* simple Duration instead of *Eternity*: For by distinguishing *Existence* from *Essence* in *God*, as in other Created Beings, they imagine Succession of Time to have place in him, and by this means divide that which is Infinite, into Parts, and assign differences of Duration to it. Hence it is that some demand, Whether *God* hath not existed longer now, than when he first Created the *World*; or whether he did not exist longer before the Creation of the *World*, than the Time that has run from the Beginning of the *World* till now. Which Questions are occasion'd by their separating the *Essence* of *God* from his *Existence*, and supposing that the *Eternity* of *God* may be understood, without the contemplation of his *Essence*; or because they have not distinguish'd Duration from *Eternity*, but have concluded them to be confounded together. For Duration is an Attribute of the *Existence* of things, not of their *Essence*. Who will not say that the Propositions, *Twice three make six*; *Nothing is made out of Nothing*; which are only said to be true according to their *Essence*, that they have continued longer now than at any other time? Wherefore Duration is only an Affection of *Existence*; whereas *Eternity* cannot be conceived without the *Divine Essence*; and forasmuch as the *Existence* of *God* is contain'd in the Conception of his *Essence*, we are also to attribute *Eternity* to him, and not Duration.

Efficient Cause of himself.

II. This Opinion destroys the Nature of God.

III. Necessary Existence is contain'd in the Nature of God.

IV. They who distinguish God's Essence from his Existence, take away his Eternity.

X. Neither could they be Omnipotent, or All-knowing,

IX. If God exist, he must be One.

XII. The Heathens did not own many Gods.

I. The Error of some, who say, that God was the

S

There

V.
The Nature
of God in-
cludes no
Conception
of Eternity.

Therefore we say, that all Creatures Enjoy Existence, forasmuch as it doth not belong to their Essences; but is in a manner foreign to them. But this cannot be affirm'd of God, because his Existence is not distinct from his Essence, and is GOD himself. Besides, all Creatures, whilst they enjoy the present Time and Existence, may be said to have it to come, forasmuch as their Existence is without them, and only successively bestowed upon them: Whereas we cannot say of the Divine Existence, that it will be, or is to come, because he has now the same Existence he will have for ever; Actual Existence in him being like all his other Attributes, which denote no difference of Time in Him.

VI.
Whether
the Mind
of Man
hath a per-
manent
Existence,
as God
hath.

It may be Objected, That some Philosophers and Divines hold, that the Duration of the Mind of Man is Permanent, and as they express it, All at once, and ye none of them attribute Eternity to it: So that accordingly, tho' the Existence of God have no Parts whereof some are before the other; yet for all that Duration may be attributed to him.

VII.
An Answer
to this
Doubt.

I answer, That Permanent Duration can only improperly be attributed to the Mind of Man, because we find a manifest Succession in our Thoughts, whereof nothing is to be found in the Divine Perception. But to explain my Mind more fully, I think that Permanency is very improperly attributed to Creatures, forasmuch as the most Perfect of them, cannot all at once admit all the Attributes and Modes it is capable of. For as it implies a Contradiction for a Body at one and the same time to admit several Figures, as to be Square and Round, to Move and Rest, so neither can a Created Spirit affirm and deny the same thing, or comprehend all those things with one Thought, which it is capable of knowing. But GOD possesseth all Perfections, and all Attributes, at one and the same time, neither is any of them before or after the other. And therefore Permanence appertains only to GOD, and Duration to all other Beings. Besides, since all Creatures are Created by God with equal dependency, and have their Preservation no longer than he pleaseth to continue it; it follows, that their Duration is not permanent, but successive, and can indeed be nothing else but a continual Reproduction, by which they persevere in their Beings.

CHAP. IX.

That GOD is Infinite, and how we are to understand, that he is Circumscrib'd in no Place.

I.
All things
are not
contain'd
in some
place.

Amongst those Prejudices, which we have taken in from our Childhood, and which some to this day hold for Truth, there is none more dangerous in Philosophy than that which ARISTOTLE teacheth in the Fourth Book of his Natural Philosophy, the First Chapter, viz. That all things are somewhere, that is, contained in some certain Space; because he supposed whatsoever is not, to be no where; which he takes to be so notorious and evident, that he is not afraid to rank it amongst Common Notions, and to esteem it an indubitable Truth. Wherefore also in his First Book of Heaven, the Third Chapter, he assigns the Highest place to the Gods, as most becoming their

Dignity, and whence with greater ease they may take a View of all Things. And in the same Book, Chap. 2. he disputes against the most ancient Philosophers, and denies God to be diffus'd through all Things, as supposing it most unworthy the Divine Majesty to be present with the Earthly World.

But that this is an Erroneous Opinion, appears from the Immensity of GOD, and the Existence of Spiritual Things: For it is evident that God and Immaterial Substances are, or have a Being, and yet they are not comprehended in any determinate Place. For to be in a Place is the Property of Extended Beings, and cannot be attributed to an Immaterial Substance void of all Extension. If at any time Places be attributed to the Soul, this is not with respect to its own Essence, which consists only in Cogitation, but with respect to the Body, to which it is joyned; because it cannot be, but that the Body being limited to a certain Space, the Soul, which is intimately present with it, may be said to be included in one place, rather than in another. But if the Soul be considered by it self alone, forasmuch as it is a Thinking Substance and void of all Extension, it cannot fill any Space, nor have any situation amongst Bodies; for otherwise it would be Divisible and Mensurable, which is repugnant to the Nature of an Intellectual Being.

And as for GOD, he is much less comprehended in any Place: For tho' he be said to be every where, yet may he also be said to be no where; forasmuch as his Immensity is unbounded and diffus'd through all Places. But because all do acknowledge, that the most Perfect Being hath no Bounds, either of his Duration or his Presence, the only difficulty will be in the Explication of the Divine Immensity, viz. in what sense God is said to be Infinite, and so diffused through all, as to be every where.

Some, whom I call Vulgar Philosophers, derive the Immensity of God, from his Presence in every place, supposing God to be every where, because there is no place in which he is not present, or which is not filled by him. But these seem to Attribute Extension to God, by conceiving to partake of Quantity, as Occupying all places: And therefore would think his Greatness to be Finite, if there could be any place, in which he were not present, and coextended with it.

Whereas we know that God was, before there was any Space; for what Place did God fill before the Creation of the World? If God therefore did Exist before there was any Space, it is evident that being in a Space is not Essential or Proper to him.

Wherefore to leave this gross way of Philosophizing, we say, that God is precisely Infinite, forasmuch as all Created things, are every moment as it were anew Created, and cannot Exist without his continual Influx: For the perpetual dependence of the Creatures, doth clearly Evidence Gods Omnipresence; because those things which are in Nature, are not preserved by any Force or Virtue of their own, but only by the Essence of God, and by his Favour continue in their Beings. Neither is a less potent Cause required to the Preserving of things, than was to the Creation of them. For from this that a thing now Exists, it doth not follow, that it

II.
Immaterial
things can-
not be said
to be in a
Place.

III.
God is com-
prehended
in no Place.

IV.
Some falsely
suppose God
to be every
where by
his Pre-
sence.

V.
God, before
the Crea-
tion of the
World, was
not in any
Space.

VI.
God is said
to be every
where, be-
cause all
Created
things per-
petually
depend
upon him.

it shall *Exist* the next moment, since there is no necessary Connexion of the *Parts* of time, but one of them is alway distinct from the other; so that *God* must influence his *Creatures* in the same manner for their *Conservation*: In which *Conservation*, and presence in every thing, the *Immensity* of *God* doth consist. Thus *God* is said to be present to our *Minds*, because he is with every one of our *Thoughts*, and concurs to every determination of our *Wills*. And he is said to be present to our *Bodies*, because he doth dispose, move and make them rest. Lastly, he is present to all other things, because he doth as it were continually produce them anew, cherishing and preserving them by a way that surpasseth our Understanding.

VII. *
God is not present every where by his Power, but by his Essence.

Neither can I assent to those who say, that *God* is present every where, not by his *Essence*, but by his *Power* only, by which they seem to divide his *Power*, from his *Essence* and other *Attributes*; whereas indeed all things that are in *God*, are one with his *Essence*; nor are his *Attributes* any thing else, but divers *Modes* of *Thinking*. For they must be fain to confess that this *Power* is something that is *Created*, or something that is only accidentary to the *Divine Essence*, without which he may be understood or conceived. Now it is the most absurd thing to make it a *Creature*, since whatsoever is *Created* doth stand in need of the *Divine Power* for its *Existence*; and since this *Divine Power* it self is supposed to be a *Creature*, it will stand in need of some other *Power* to preserve it, and by this means we shall make a *Progress* to *Infinity*. Or if they will rather make this *Power* to be accidental to *God*, and distinguish from his *Essence*, then they must be forced to admit, that *God* is not a most *Simple Substance*; because, according to their saying, he would be compounded of his *Essence* and that *Power*. Wherefore we conclude, that *God* is present to all things by his *Essence*, and that he is in every *Place*, forasmuch as he continually procreates and conserves the things which he hath *Created*.

VIII.
The Immensity of God is only an External Denomination.

Hence we may perceive the false way of *Reasoning* used by the *Peripateticks*, who to make out the *Doctrine* of *Gods Immensity*, have invented imaginary *Spaces*; as if the *Immensity* or *Omnipresence* of *God* were any thing else, but an *Extrinfecal Denomination*, taken from his *Works*; forasmuch as he *Works* in all *Created things*, and by *Reason* of that *Operation* is said to be present with them. For *Immensity* in *God*, seems to have some *Affinity* with *Creation*; and as *Creation* is *Attributed* to *God*, from the *Action* of *Creation*, since before the *Creation* he could not be called a *Creator*: So likewise *Immensity* is *Attributed* to *God*, with respect to his *Creatures*, since he could not be present with them, before they were *Created*.

CHAP. X.

That God is the most Simple Being.

I.
What Composition is, as it is opposed to Simplicity.

AS things are more clearly and distinctly perceived by comparing them by their contraries; so I suppose it will be of great use for the Explaining of the *Simplicity* of *God*, to unfold what *Composition* is, and to what distinction of parts it answers. Now *Composition* is the *Coalition* or *Union* of many things, which presupposeth a distinction of *Parts*, since nothing can be united to it self, but

to another. And it is various according to the diversity of the *Parts*, of which things are compounded.

For one *Composition* is *Real*, which consists of *Parts* really distinct; as a *Man* is compounded of *Soul* and *Body*, because we can clearly and distinctly perceive the *Mind* without the *Body*, and the *Body* without the *Mind*. Another is *Modal*, which consists of a *Subject* and *Antecedent* or *Mode*; as a *Prudent Man* is compounded of a *Man* and *Prudence*; and is known by this Mark, that tho' a *Substance* may be clearly perceived without the *Mode*, by which it is diversified; yet on the contrary, the *Mode* cannot be clearly understood without the *Subject*, whose *Mode* it is. The third sort of *Composition* is called, a *Composition* of *Reason*, which consists of the *Genus* and *Difference*, as when *Man* is said to be compounded of an *Animal*, and *Rationality*. Which consists in this that we cannot perceive a thing clearly, if its *Attribute* be excluded from it: As *Extended Matter* or a *Body*, is said to differ only by *Reason* from *Extension*, because we cannot conceive a *Bodily Substance*, if *Extension* in *Length*, *Breadth* and *Depth* be separated from it. And therefore, such kind of *Attributes* as these are not called the *Modes* of *Things*, but only *Modes* of *Thinking*, forasmuch as by the help of *Reason* only, they are distinguished from those things, with respect to which they are so called.

These things presupposed, it will not be difficult to shew that *God* is no *Compound*, that is, that he hath no *Parts* that are *Really* or *Modally* distinct from each other. For there is no more certain *Argument* of a real *Distinction*, than that the *Idea* of one thing is perceived, not to be the same with the *Idea* of another thing; or to speak in *School Terms*, that the one can *Exist* without the other: But it is manifest, that no such distinction is to be found in *God*, forasmuch as all his *Attributes* are *Essential*, and not *Separable* from him, but by the *Operation* of our *Mind*.

Moreover the things that go to the making up of any *Compound*, must at least by *Nature* be before the thing *Compounded*, or that is made up of them: Thus every *Cause* is said to be before its *Effect*; *Substance* before *Accidents*; and *Subjects* before *Adjuncts*: And therefore those *Substances*, by the *Union* of which *God* is supposed to *Exist*, must of necessity have been before him, since we understand them to be, before they constitute the *Divine Essence*. Thus *Matter* and *Form*, which are considered in *Natural Philosophy*, as the two *Principles* of a *Natural Compound*, are apprehended to be, before they do constitute their *Compound*. And in like manner, if really distinct *Substances* were found in *God*, they would be intelligible to us, before that they were *Attributed* to him; yea tho' they should never be *Attributed* to them.

And forasmuch, as we acknowledge only two general heads of things, viz. *Material* and *Spiritual*, we must of necessity suppose, that the things of which *God* should be composed, must be *Corporal* or *Intellectual*. If the first, it will follow, that seeing a *Body* is the immediate *Subject* of *Local Motion*, *God* is *Divisible* and *Limited*, yea, *Subject* to *Passion* and *Alteration*, all which include *Imperfection*, and consequently are repugnant to the *Divine Nature*. If they be supposed to be *Spiritual*, since there is a real distinction between

II.
There is a three-fold Composition: Real, Modal and that of Reason.

III.
God does not consist of Parts

IV.
Nothing in God is before other, and therefore no Composition

V.
God is not compounded either of Corporal or Spiritual Parts.

tween them, and one of them according to the Rules of Logick, can Exist separate from the other, consequently there will be as many Gods as there are Substances, that are supposed to constitute God. For seeing they can Exist by themselves, and need no assistance from any other to their Conservation, they will also have power to confer upon themselves all the Perfections, which belong to God alone. Than which nothing more absurd can possibly be imagined by the Mind of Man.

VI.
There are
no Modes in
God, out
of which
he may be
said to be
compounded

We say therefore, that there are no Substantial Parts in God, into which he can be divided, or from the Union and Coalition whereof he doth consist. Neither is there any Composition in God, out of a Subject and Accidents or Modes; because Modes arise only from the various Change of the Substance, which therefore cannot be supposed in God, because in him there is no Change or Variation. Wherefore it follows, that whatsoever is in God, is only distinguishable by our Thoughts, because every Attribute of God may be called his Essence, and have the name of supreme Perfection: And therefore are neither more nor less than the one God, in the Unity of Nature. So that we must conclude God to be the most simple Being, utterly devoid of all Parts, or Divisibility.

CHAP. XI.

God is true, and as he cannot be deceived,
so neither can he deceive.

I.
If God was
not true,
we could
not be assured
of any
thing.

THO' Human Cogitation be commonly held to be the Rule of Truth, and whatsoever, we clearly and distinctly perceive, is supposed to be true; yet all this certainty would come to nothing, if God were not true, and most remote from the least suspicion of deceiving us: For how should we believe Revelation, if it were possible for God to deceive us? For he having bestowed upon us our Intellectual Faculties, it might be questioned, whether it was not his pleasure to make us such, as that in the use of them, we should be deceived, and against our will fall into Error.

II.
Truth is a
necessary
Ingredient
of a Being
absolutely
Perfect.

But this Doubt will be easily removed, and the Divine Veracity cannot but be manifest, by considering that all Perfections that can be conceived by us, do belong to God. For, forasmuch as he is the Highest Being, he must also of necessity, be the most Sovereign Good and Truth: Now it is as much a Contradiction, that any Falsity should proceed from the Highest Truth, as that any Evil should come from the Highest Good: Which yet would be, if in the use of our Faculty of knowing, that is, in assenting to things that are clearly and distinctly perceived by us, we should fall into Error. And indeed seeing that whatsoever is real in us does proceed from him, and that the Faculty we have for the knowing of Truth, and distinguishing it from Falsehood, is Real, we could not but take him for a Deceiver, in case our Faculty could not reach the Object, but should always take Falsehood for Truth. Than which nothing can be imagined more injurious to the most Perfect Being and the Fountain of all Good.

III.
That the
Most Perfect
Being

Besides by the Name God, we understand the most perfect Substance; and Imposture or Deceit is a manifest Imperfection, because it has a non-En-

tity for its End, that is, something that is not true; for all Deceit includes Falsity, which being opposed to Truth, it must be carried to that which is no Truth, that is, a non-Entity: So that from hence it will follow that God cannot without a contradiction be said to deceive us.

Lastly, Tho' perhaps amongst Men, it may be accounted a piece of Cunning to deceive others, yet Falseness or a will to deceive others, proceeds from Fear or Malice: And forasmuch as Fear supposeth Weakness, and Malice the want of Goodness, neither of these can be admitted in God; and consequently neither can a Will to deceive be ascribed to him; yea, he must be supposed to be the Highest Truth, and not thought a Deceiver upon any account whatsoever.

You will object that he who concurs to those Actions of the Will, or those Judgments by which a Man is deceived, he is to be looked upon as the Cause of that Man's Error: But God so concurs to those Judgments of Men, by which they are deceived; therefore God is the cause of Men's Errors.

This Objection is easily answered by distinguishing between the Material and Formal, or between an Act and its Privation. For all Acts are true and Good, forasmuch as they depend on God; and as it is a greater Perfection in Man, that he can exert them, than if he could not. But Privation, wherein alone the Formal Reason of Falsity doth consist, doth not stand in need of any Divine Concurrence, because it is No thing, and with Relation to God, is not to be call'd a Privation, but only a Negation.

I know that some Divines seem of a different Opinion, who think that God can deceive Men, by inspiring them with Ideas that deceive them; and that he does this of his free Will, as being the Supreme Lord of all, and therefore may deal with his Creatures, as he listeth. So as that they are clearly persuaded that they feel something, which indeed they do not, according as it happens to the Devils and Damned Souls, who think they are tormented with Fire in Hell, when indeed there is no Fire there at all; or if there be any, it is Material, and so cannot affect Pure Minds.

I Answer, That GOD does not deceive, or by false Apparitions delude the Devils or Damned Souls; because the Fire wherewith they are tormented, is not only an Idea of Fire impressed on them by God, but the true substance of Fire wherewith they are tormented, and sensibly affected. For why may we not suppose, that God can joyn the Soul of Man with some Body, and so unite his Thoughts to the Motions of that Body, that according to the greater or lesser force of the one, a greater or lesser sense of Pain may be excited in the other? For as we see that the Soul of Man is kept link'd to the Body, so it may as well, by the Divine Power, be detained and suffer by Corporeal Fire (as we suppose that in Hell to be) seeing that this is consonant with the Scripture, and establisheth the Truth of GOD.

If any one urge further, That GOD doth sometimes harden the Hearts of Sinners, and so blind their Minds, that they condemn his Commands, and run headlong into the greatest Sins, as appears by PHARAOH, whose Mind the LORD did so incline to Evil, that it was not in his

should deceive us,
implies a
Contradiction.

IV.
Deceit is
an Argument
of Fear or
Malice.

V.
An Objection
from the
Concourse
of God.

VI.
God doth
not concur
to the Formality
of Error.

VII.
Whether
God may
be said to
deceive the
Devils and
Damned
Souls in
Hell.

VIII.
The foregoing
Doubt
answer'd.

IX.
In what
sense God
is said to
blind the
Minds of
Men.

his Power to obey his *Precepts*. Besides, we read in *Scripture*, That GOD put the *Prophets* upon foretelling Things that did not come to pass; as appears from the History of *Jonah* the *Prophet*, who declar'd from God to the *Ninevites*, that their City should be destroyed within forty days, which never came to pass.

X.
Answer.

I Answer, That tho' *Pharaoh*, by the Perverseness of his Will did refuse to obey God, and to dismiss the *Children* of *Israel*, notwithstanding the frequent Warnings he had had from above; yet is not this so to be understood, as if God by any positive Influx had hardened his *Heart*, and forced him to despise his *Commands*; but only that he withheld *Efficacious Grace* from him, and left him to his own wicked Will. And as for *Jonah*, who foretold the ruin of the City *Nineveh*, that is not to be called a *Lye*, but rather a *Threatning* or *Denunciation*, the Execution whereof depended on their *Obstinacy* or *Conversion*, as appear'd by the Event: For the *Ninevites* Repenting in *Sackcloth* and *Ashes*, and earnestly deprecating the *Divine Displeasure*, did escape the *Prophet's* *Commination*.

XI.
God may sometimes deceive us for our Good.

Tho' it be a most undoubted *Truth*, that it is repugnant to the *Divine Perfections* to deceive any one; yet this does not hinder, but he may make use sometimes of a *Prudent Deception* towards us for our profit, in like manner as *Physicians* and *Parents* sometimes deceive their *Patients* and *Children* for their good and advantage. Neither can God properly be said to deceive us, when things appear to us otherwise than they are; because God is not the cause of that *Deception*, but we our selves, who judge of *Bodily things* according to their *External appearances* before that we have sufficiently examin'd them; forasmuch as in these and the like *Appearances* we should suspend our *Judgment*, before we do determine any thing concerning their *Truth*.

XII.
We cannot be said to be deceived, when we imagine the Sun to move, and the Earth to stand still.

Thus GOD cannot be said to deceive us, when by the *Earths* whirling about its *Axis*, the *Sun* seems to us to rise and set; but we rather deceive our selves, when we attribute *Motion* to the *Sun*, and *Rest* to the *Earth*, before we have fully discuss'd the *Point*: When indeed we ought to suspend our *Judgment* until having weighed the *Reasons* on both sides, we did clearly and distinctly perceive, to which of these *Bodies* the motion we perceive were to be ascribed. Neither are the *Common People* look'd upon to be absolutely in an *Error*, when they suppose the *Sun* to move every day about the *Earth*, tho' it be not true, because herein they follow what seems probable, which is sufficient to free them from the imputation of being deceived.

XIII.
From God's Veracity we may conclude, that whatsoever is clearly perceived by us, is true.

Hence it follows, that whatsoever is clearly and distinctly known by us, is true: For since the *Light* of *Nature*, or our *Faculty* of *Knowing*, hath been given us by God, it can reach no *Object* which is not true, so far as it is reached by it; that is, forasmuch as it is clearly and distinctly perceived. For God might with reason be look'd upon as a *Deceiver*, in case he had given us a *Faculty* that embraced *Error* instead of *Truth*: Wherefore forasmuch as *Mathematical Truths* are most clear and evident, so as to thrust themselves upon our *Understandings*, we ought not in the least to suspect them, but receive them as undoubted *Truths*.

CHAP. XII.

That GOD is most highly Intelligent, or Omniscient.

IT will not be any hard matter to make out, that GOD is *Omniscient* or *All-knowing*, and that at one view he comprehends all things, if we remember him to be the *Most perfect Being*, in whom no defect or limitation can be conceived, which would not be if his *Knowledge* were finite, and that any thing could escape his *Understanding*. Therefore the *Ancients* called GOD, the *Mind*, or *Soul* of the *World*; not only for that he was diffused throughout the *Universe*, and did animate all *Things*; but also because he knows them all, and pierceth their most *Secret* parts. For *Ignorance* is a mark of *Weakness* of *Soul*, and that *Being* cannot but be *Imperfect*, whose *Understanding* is bounded by any *Bound* or *Limit*, beyond which it cannot reach.

I.
Omniscience is included in the Conception of a most Perfect Being.

But because *Discourse* and *Reason* serve to illustrate the *Truth* of *Things*, I shall make use of this Argument: Either GOD understands all things, or some things only, or nothing at all. If he only understand some things, then his *Understanding* is supposed imperfect, which no body will say of God, that is persuaded of his absolute *Perfection*. But if he knows nothing, then certainly he cannot be supposed to be God. Wherefore it follows, that as God contains all *Perfections*, so he is endowed with *knowledge* in the highest and most transcendent degree.

II.
This Point further made out by Reason.

I say, in the most transcendent degree, because *Human Cogitation* is very different from the *Divine*. For the *Idea's* of *Men* are bounded by the *Objects* that are without them, and according to the diversity of things which it contemplates, are said to be either *clear* or *obscure*. For it does not depend of us, that our *Idea's* do represent this or the other thing to us, they being only *Modes* of *Cogitation*, and as such are all of them equal, all their difference proceeding from the *Objects* they represent; so that some hold forth to us an *Extended Substance*, others a *Mind*; some *Simple things*, others *Compound*; all which variety the *Idea's* borrow from the *Things* themselves. For it cannot be question'd, but that those *Idea's* which represent some *particular Substance* to us, contain more *objective Reality*, than those which only exhibit *Modes* to us, which are only the determinations or limitations of *Substance*. But the *Divine Knowledge* doth not thus depend on the *Creatures*, neither are his *Conceptions* bounded by any things without him; but all *Created Beings* derive their *Essence* from his *Understanding*, and according as they are determin'd by the same, do obtain divers degrees of *Entity*. For the *Divine Intellect*, whereby God knows the *Creatures*, is the same thing with his *Will* and *Power* that does determine them, and are only distinguish'd by us, according to our various ways of considering them.

III.
How the Divine Knowledge is distinguish'd from the Knowledge of Men.

Wherefore we are not to suppose any *Object* of the *Divine Science* to be without himself, who is alone the *Object* of his own *Knowledge*; or to speak more properly, He is himself his own *Knowledge*. For should we suppose, that *Created Beings* were before the *Divine Intellect*, and that as *Objects* they did terminate his *Idea's*, they must be supposed to have a *Nature* and *Essence* independent

IV.
There is no Object of God's Knowledge, that is without himself.

on God, as being at least by Nature before him. Which to assert would be as foolish, as to say that a *Pourtraiture* drawn by a Skilful *Limner*, is the *Object* of that Art: For a *Limner* stands in need of *Pencils* and *Colours*, to perform his *Work*; whereas GOD did not stand in need of any thing for the *Creation* of the *World*, but all *Created things* did proceed from his *Understanding* and *Free Will*; not only as to their *Existence*, but as to their *Essence* also.

V.
Indifferency
in God is
the Highest
Perfection.

Whence it appears, that *Indifferency* which is an Imperfection in Man, and is held to be the lowest degree of his *Liberty*, is the *Highest Perfection* in God, as being a sign of his *Sovereign Empire* and *Power*, who is unbounded by any *Laws* or *Rules*, and the sole *Author* of all *Order*, *Truth*, *Justice* and *Goodness*. For it implies a *Contradiction*, to suppose that the *Divine Will* was not indifferent to all things, that have been or shall be made. Because no *Goodness* or *Truth* can be imagined, the *Idea* whereof was in the *Divine Intellect*, before that his *Will* had determined to make it so.

VI.
How God
knows Sins,
and those
things
which are
called En-
tia Ratio-
nis. Enti-
ties of Rea-
son.

Some Question whether the *Divine Knowledge* doth extend it self to all things, and whether God besides *Positive things*, that is, real *Substances*, doth also know things *Privative* and *Fictitious*, such as are *Sins*, *entities of Reason*, &c.

VII.
Answer.

For Answer I say, that God knoweth all things whereof he is the *Efficient Cause*, because as was said in the Chapter of *Gods Immensity*, all things are continually procreated by him, as not being able to continue one Moment without his *Concourse*: But *Sins* being no real things, and depending on the *Will* of *Man*, are not known by him without the *Minds* of *Men*. And as for *Entities of Reason*, forasmuch as they are nothing else but *Modes of Thinking*, which are used for the easier *Explication* of the things we know, or the better retaining of them; these are no otherwise understood by God, than as he is the *Procreator* and *Conservator* of our *Minds*. For if we enquired what is meant by an *Entity of Reason*, we shall find it to be a *meer Nothing*, without the *Understanding*. But if we have regard to the *Modes* themselves of *Thinking*, they may be said to be *real Entities*. Thus, when I enquire what is *Genus*, I demand nothing else but the *Nature* of that *Mode of Thinking*, which is truly considered as a *Being*, and differs from a *Species*, which is another *Mode of Cogitation*.

VIII.
God under-
stands En-
tities of
Reason on-
ly foras-
much as
they are
conceived
by us.

Now God doth not contain any of these *Entities of Reason* or *Notions*, as if he stood in need of these *Modes of Cogitation*, to retain the things that he understands; but only inasmuch as the *Mind* of *Man*, whose *Modes* they are, is perceived by us to be preserved and maintained in its *Being* by God. We conclude therefore that God is *All knowing*, and that he contemplates all things by one only most *Simple Idea*; for to speak properly, God for no other Reason is called *Omniscient*, but because he has his own *Idea*, which being nothing else but his *Essence*, is therefore inseparable from him, and consequently extends it self to all positive or real *Objects*.

CHAP. XIII.

That God is Good, and doth Good.

I.
In what
Sense God

Seeing that no *Creature* exists by its own *Power*, and that all thing derive their *Essence* from God,

we must conclude that God is Good and Beneficent. For as by his comprehending all things he is *All knowing*, and by his Power to do all things, *Omnipotent*: So because he hath *Created* all things, he is said to be *Good*, and because he preserves the same, *Beneficent*.

is said to
be Good.

This will more clearly appear, if we consider what *Good* and *Evil* is, and wherein precisely the *Nature* of both doth consist. A thing considered by it self apart, cannot be said to be *Good* or *Evil*, but is denominated such with respect to an other thing, to which it is profitable or hurtful. And accordingly, the same thing may at the same time, be said to be both *Good* and *Evil*. So the *Punishment* inflicted on a *Criminal* is *Good*, forasmuch as it conduceth to the *Safety* of the *Commonwealth*, and to deter others from committing the like *Crimes*: And yet it is *Evil* to the *Criminal*, because by the same he suffers *Death*, which deprives him of *Life*, being the dearest thing he enjoys. So likewise the *Sea* is of great use for the carrying of *Ships*, and in that regard is a *Good* to the *Merchants*; but *Evil* when raging by a *Storm* it *Swallows* and *Shipwracks* their *Vessels*. Yea, there be many *Good things*, which are not such to all: Thus, to be in *Heaven* and to enjoy the company of the *Blessed*, is a *Good*, yea the greatest *Happiness* to *Man*, but yet to *Brutes* and *Plants* it is neither *Good* nor *Evil*, as having no *Relation* to them.

II.
Good and
Evil are
Respective
Terms.

GOD therefore is said to be supremely *Good*, because he does *Good* to all, and is the *Conservator* of all things, for all things are preserved by his *Omnipotence*. Moreover, forasmuch as there is no *Connexion* between the parts of *Durations*; and it doth not follow, that because the *Creatures* exist to day, they will continue to morrow: We may say that *Gods* Conservation of his *Creatures*, is a continual production of them. Neither doth it oppose this *Truth*, that the *Will* of *Man* is free, and is oft determined by things without it: Because even those very *Actions* are determined by *God*, and are not exerted but by his *Good-will*, as will be said more at large in the following Chapter. For it implies a contradiction, that any thing should determine the *Will*, and that the *Will* it self should not be determined by *God*, to whom all created things are *Subject*.

III.
God is said
to be Good,
as being
beneficial
to all.

Gods Beneficence doth not only appear in the *Creation* of the *World*, and the preserving of all *Creatures*; but he hath also from *Eternity* testified his *Love* unto us, by electing us from before the *Foundation of World*, and by loving us with an *everlasting Love*. For as *Heat* cannot but warm, and *Light* illuminate, so the highest *Love* cannot but in the highest degree love it self, and all things proceeding from him. And this *Eternal Love* of God is manifested by a two-fold effect, viz. the *Mortal Life* we *Live* here, and the *Immortal Life* we hope for, hereafter. With reference to the present *Life*, he hath adorned the *Heaven* with *Stars*, that they might assist inferior things with their *Light*, and promote the innumerable *Generations* of *Natural things*; he hath distinguished the *Elements* in their proper Place, endowed them with *Qualities*, and made them by their inborn *Virtues*, to concur to the *Mixtion* and *Production* of all things; he hath appointed the *Fire* for *Action*, the *Air* for *Respiration*, the *Water* and *Earth* for *Fruitfulness*, and the *Production* of so many kinds of things for necessity and delight, but the chiefest Pledge of *Gods Love*.

IV.
The Love
of God to
Mankind
is from E-
ternity.

CHAP. XIV.

Of the Omnipotence of GOD.

Love towards us; is, that he hath predestinated us to the Adoption of *Children in Christ Jesus*, so as that we have *Redemption* by his *Blood*, and the *Forgiveness* of *Sins*, according to the *Riches* of his *Grace*. For *Grace* hath preceded *Merit*; neither doth *Grace* come from *Merit*, but *Merit* from *Grace*. He gave for *Nothing*, or out of *meer Grace*, who found *Nothing* why he should *Save*, and *Much* why he should *Damn*: He prevented us by the *Blessings* of his *Sweetness*; for that *Grace* tastes *sweeter*, which helps even those that have ill-deserved, and entertains *Thoughts* of *Peace* towards us, whilst we do the *Works* of *Death*. S. Austin, Sermon 15. de verb. Apost.

VI. But you will say, What shall not GOD be good then, except he do Good to *Mankind*, and preserve the *Universe*? What can be imagin'd more absurd, than not to acknowledge GOD Good, as well as *Immense*, *Wise*, and *Powerful*?

Notwithstanding this Objection, we must assert, That the *Attribute* of *Goodness* did not belong to God before the *Creation* of the *World*; because a Thing considered in it self, and without respect to others, cannot be said to be either *Good* or *Evil*: Neither needs this seem strange or absurd to any one, forasmuch as the *Goodness* we speak of here, denotes a *Respect* between God and his *Creatures*, as his *Immensities* does, which consists, as we have seen, in that *Operation* whereby he continues them in *Being*. So that as supposing they were not, tho' he would be present to Himself; yet *Ubiquity*, or *Omnipresence* could not be attributable to him; so before the *Creation* of the *World*, tho' GOD be *Good* by his own *Essence*, yet because there was nothing on which he could exercise his *Benevolence*, he was only *Potentially Good*, *Merciful*, a *Judge*, a *Creator*, &c.

VII. But some will say, If GOD be *Good*, why doth he permit the *Corruption* of *Nature*, and the *Sins* of *Men* to offend his *Divine Majesty*?

VIII. To which I Answer, First, That it is not repugnant to the *Divine Goodness* that there are *Sins*, and that *Men* swerve from their *Duty*; yea, it seems more to comport with his *Omnipotent Goodness* to bring *Good* out of *Evil*, than not to suffer *Evil*. But yet it is not our business to enquire over-curiously, why God permits *Sin*, lest we should seem to endeavour with the scanty Line of our *Reason*, to fathom the depth of the *Divine Wisdom*.

IX. In the Second place I Answer, That it is not contrary to the *Divine Goodness*, that he hath not made his *Creatures* so perfect, as to place them out of the reach of *Error*, or danger of *Falling*; and that he hath pitch'd upon such an *Order*, in which *Sins* take place; forasmuch as *Man* *Sins* without any force put upon him; neither can the *Guilt* of it be imputed to God: For God did not from *Eternity* decree *Sin*; neither did he decree, that *Sin* should be possible; for seeing *Sin* is no positive thing, but a deficiency of *Reality*, it cannot be of God, but he only hath established that *Order*, in which he sees the possibility of *Sin* before his *Decree* and *Will* concerning it. And therefore upon this *Hypothesis* only it follows, that having established such an *Order*, and making positive Things possible, he can be said the *Author* of *Sin*; forasmuch as by the said *Order*, *Sin* is made *Possible*, which in this sense is not repugnant to the *Goodness* and *Holiness* of GOD.

NO Man that ever own'd a GOD, deny'd him to be *Omnipotent*: This is a Notion all *Men* brought into the *World* with them; who therefore when they are in any affliction or danger, lift up their *Hands* to *Heaven*, and send up their *Prayers* to him for the thing they wish for, and thereby tacitly acknowledge his *Omnipotence*. Yet there are some *Philosophers* who seem to destroy this *Notion*, who assert the *Essences* of Things to be *Eternal*, as if without the *Power* of God they had some *Nature* of their own, to which God at a certain time did vouchsafe *Existence*, and made them to be *Actual Beings*. And therefore they say, that *Possible things* only, that is, such as are so in their own *Nature*, can be produc'd by God, and that his *Power* doth not extend it self any further.

But because this *Doctrine* seems to derogate from God's *Omnipotence*, we will endeavour to shew the *Falsity* of it, by declaring what the true *Nature* of a *Possible*, *Necessary*, and *Contingent Being* is, and whence they take these *Affections*. A *Necessary Being* is said to be such with a twofold respect, either with respect to its *Essence*, or to the *Effective Principle* whence it proceeds. After the first manner, we know that God only doth necessarily *Exist*; and therefore he is said to *Exist* so, as that he cannot but *exist*; because *Existence* is involved in his *Conception*, so that his *Essence* cannot be understood without it. But after the Second manner, that is, with respect to the *Effective Principle*, *Corporeal things* are said to be *Necessary*, forasmuch as they can be produced by God; but not with respect to their own *Essence*, because we can clearly and distinctly understand the same without *Existence*, and therefore they can never exist by virtue of their *Essence*. That is call'd a *Possible Being*, whose *Efficient Cause* is known to us; but yet we do not know, whether he be determined to produce it or no; and therefore is commonly described, That which hath not been, but might have been; and in this sense all things besides God are said to be *Possible*. But if we consider only their *Nature*, and not their *Productive Cause*, we shall call all things *Contingent*; because with respect to their *Natures*, no necessity of *Existing* is found in them, as in God: Neither is there in them any *Repugnancy* or *Impossibility*, but that they may be; and therefore in case they do exist, they exist so, as that they may not exist.

We will now shew, That all things that are now, or are to come, have their Dependence on God; and that there is nothing in *Nature*, that doth not proceed from his *Decree*. For seeing no *Creature* exists by the necessity of its *Essence*, it follows, that they must all borrow their *Being* from the *Divine Decree*. For it is evident by the *Light of Reason*, that it is impossible a thing should exist, which hath no *Internal* or *External Cause* of its *Existence*: Now no *Creatures* can exist by the *Power* of their own *Nature*, and therefore we must have recourse to one only *External Cause*, viz. the *Divine Decree*, for their *Existence*; in which *Divine Decree*, if their *Existence* be not found, they are to be look'd upon as *Impossible*, forasmuch as they cannot be produc'd by any *Cause*. From whence

I. It is an inborn Notion with all Men, that God is Omnipotent.

II. What a Possible, Necessary and Contingent Being is.

III. All things present, and things to come, depend on God.

VI. God is said to be Good and Infinite, respectively.

VII. How it comes to pass that God being Good, permits Sin.
VIII. The First Answer.

IX. The Second Answer.

whence it evidently follows, not only that the *Existence* of all *Creatures* doth depend of *God*, but also their *Nature* and *Essence*: for seeing there is no perfection which is not in *God*, there can be no *Essence* in the *Creatures*, which should be the cause of *Gods* knowledge. Wherefore we must conclude that all *Creatures* before *Gods* Decree were nothing, and consequently that of themselves they have no necessity to exist.

IV.
God is the
Efficient
Cause not
only of sub-
stances, but
also of their
Modes.

When I say that all things have their Being from the *Divine Good Pleasure*, this to be understood not only of *Material Substance*, but also of *Thinking or Spiritual*; because not only the *properties* and *Modes* of *Bodies* derive their reality from the *Will of God*; but also the *Modes* of *Minds*. For it is a meer prejudice of our Youth to imagine that the *Modes* of *Cogitation*, *Knowledge*, *Judgment*, *Affections*, and other inward *Acts* of our *Mind* do less depend on the *Divine Power*, than the *Modes* of *Material* and *Bodily things*. Because whatsoever is not *God*, is of it self altogether nothing; neither can it exist but by his *will*; for since nothing can be the cause of its own *Existence*, save *God* alone, it follows that whatsoever exists, must derive all its reality from *God as its first Principle*.

V.
In what
sense the
Natures of
things may
be said to
be immu-
table.

If it be objected that the *Essences* of things are commonly said to be *Immutable* and *Eternal*. I answer, that the *Essences* of things are only said to be *immutable*, forasmuch as they are exprest by *Definition*, and are consider'd *Universally*, as is commonly done in *Sciences*, whose certainty requires firm and stable *Definitions*. So the *Definition* of a *Mind* that it is a *Thinking substance*, is always the same, neither is lyable to any change, tho perhaps there may be a further degree of perfection in the *Mind* of one *Man*, than of another. And whereas they are said to be *Eternal*, or that their *Essence* was known from *Eternity* in the *Divine Intellect*, this does not argue any *Eternity* in them, but in *God*; since to be known in the *Mind* of *God*, with respect to the *Creatures*, is only an *Extrinsic Denomination*, or an *Entity of Reason*, which superadds no reality to things.

VI.
No things
are Contingent
with
respect to
God.

As for *Possible* and *Contingent Things*, there are none such with respect to *God*; Because there are none that of themselves can *Exist*, and not *Exist*, or that have real *Contingency*. For surely there is no less *Power* to the *creating* of a thing, than to the *Conserving* of it; and since no *created thing* acts any thing by its own *Power*, so neither can it give it self *Existence* by the same. It remains therefore that all things must have their *Dependence* on *God*, and that the things that are, be produced by virtue only of the *Divine Decree*. And forasmuch as there is no *Change* or *Inconstancy* in *God*, we must conclude that the things which he *creates*, have from *Eternity* been decreed to be *created* by him; so that all *Creatures* from *Eternity* had a kind of necessity of *Existence*; And therefore that no Things are *Possible*, *Necessary*, or *Contingent* of their own *Nature*, but by the *Divine Decree*, which is the only Cause of all things.

VII.
Nothing
can be sup-
posed ante-
cedent to
Gods De-
cree.

Neither doth it contradict what we have said, that *God* might have decreed otherwise concerning his *Creatures*, and that upon that score they may be said to be *contingent*; For since in *Eternity* there is no *Before* or *After*, first or last, it is a *Vanity* to search after those Moments in which *God* existed

before those *Decrees*, and in which it is supposed that he might have determin'd otherwise. Wherefore since *God* without any necessity resolved to make *Creatures*, they are all of them said to exist *Contingently*, because they include no *Necessity* of *Existing*; tho with respect to the *will* of *God* they exist *Necessarily*: Forasmuch as no greater necessity can be conceived in Things than that whereby an *Effect* follows from an *Efficacious Principle* and a *Determinate Efficient Cause*.

There is one difficulty more remains to be discuss'd, and that is since all *Creatures* are predetermined by *God*, and that there is a kind of necessity of *Existence* in them from *Eternity*, how the *Will* of *Man* can be said to depend of *God*, seeing that it is *free*, and indetermin'd. But notwithstanding this, we must say that the *Will* also is conserved by the *Divine Concurrence*, so that it is not in the *Power* of *Man* to *Will* or *Act* any thing, which is not preordained by *God*. But how these two things may be reconciled, that *God* hath decreed all the *Acts* of our *Will* from *Eternity*, and yet our *Will* remains undetermin'd, is I confess more than I do clearly perceive. I do acknowledg my *Mind* to be but of a *finite* capacity; and the *Power* of *God*, whereby he hath not only foreknown all present and future things from *Eternity*, but hath also decreed and determin'd them, to be *infinite* and *unbounded*: Yet cannot this consideration make us doubtful of the *Freedom* of our *Will*, since in all our *actions* we experience our selves to be *free*, and that it is in our *Power* to give or withhold our *Assent*; which is so manifest that we have good reason to rank it amongst first and common *Notions*.

VIII.
How the
Will of
Man is said
to depend
on God.

Hence is it that the Famous *Philosopher* in the Ninth *Epistle* of his I. *Volume*, saith. *As to Free will, if we only consider our selves, I must confess we cannot but think it to be Independent: But when we cast an Eye on the Infinite Power of God, we cannot but believe that all things must depend on him, and therefore that our free will is not exempt from his Command. For it implies a contradiction that God should have created Men of such a nature, that the Actions of their will should not depend on his will: Because that is the same as if one should say that his Power is both Finite and Infinite: Finite since there is something that doth not depend on it; and Infinite, in that he was able to create this thing Independent. But as the knowledge of the Divine Existence, must not take away the certainty of our free will: So neither must the knowledge of our free will, make us to doubt of the Divine Existence. For the Independency we experience and find in our selves, and which makes our actions blame or praise-worthy, is not opposite to a dependence of another kind, whereby all things are subject to God.*

IX.
It is a diffi-
cult thing
to reconcile
the Divine
Decree with
the Liberty
of Mans
Will.

Gods Omnipotence does not only appear in the Production of things, but also in their conservati- on: for *God* is not only the *Principle* of created *Beings* when they are making, but also when they are made. Hence it is that he preserves them by a continual Influence; and should he cease from his Concurrence, whatsoever he hath produc'd would fall to nothing; Because before they were created and he afforded them his Concurrence, they were nothing. Neither doth it contradict this, that all things that are produced by *God* are *substances*, to whom

X.
God is no
less a cause
of the Crea-
ture when
it is made
than when
it is a
making.

whom it does agree to subsist; for they are not call'd *Substances* as if they could subsist without the *Divine Concourse*, but because they are such things, as do not need the assistance of any *creature* towards their being. In which Preservation of the *creatures*, the infinite *Divine Power* is evidently exemplified, in that he hath produc'd all things so, as that they cannot subsist one moment without him, like as the Image of the *Sun* reflected in the *Water*, or in a *Looking-glass*, doth depend on the *Sun*, not only as to its being, but as to its Preservation or continuance.

CHAP. XV.

That God is the Creator of all things.

THO all the *Divine Attributes* be Eternal, and undistinguish'd from his *Essence*, yet do not all of them in a like manner agree to him. For some of them constitute his *Nature*, and can only by the operation of our *Minds* be separated from it, such as are his *Eternity*, *Omniscience*, &c. Others again presuppose *creatures*, and are only attributable to him since the beginning of the *World*, as to be a *Judge*, a *Creator*, &c. Which from *Eternity* did only Potentially belong to him. But because the *Power* to create the *World* was in *God* from *Eternity*, and that it appertains to his *Nature* to be *Omnipotent*, it is as easy to prove *God* to be the *Creator* of all things, as it is to evince him to be *Immutable*.

For whatsoever is besides *God*, either hath the Principle of its *Existence* from it self, or from another: For natural light evinceth that things can not be made of nothing. If any thing was of it self, it would want nothing; Yea, it would give it self all those Perfections it hath any *Idea* of; but nothing hath the *Power* of bestowing those perfections on it self, for otherwise it would actually be possessor of them; for the *Will* is infallibly carried to the Good it knows; and consequently it hath not the *Power* of giving it self a *Being*. If it hath its *Being* from another, we may then demand whence that other hath his *Being*, whether from it self or from another, till we come to the last *Cause*, who is the *Author* of all things that *Exist*.

Besides, the *Parts* of *time* have no necessary dependence on each other; neither doth it follow that because a *thing* is now, it will be the next Moment: Therefore to the end it may continue to exist, there must be some *Power*, which may each Moment reproduce it: But no such *Power* is in the *Creature*, and therefore there must be some *Being*, whose *Nature* includes *Existence*, and which is the *Cause* why the thing that hath existed hitherto, doth continue so to do. For tho' a thing have begun to *Exist*, yet doth not its *Essence* any more involve necessary *Existence*, than it did before its *Existence*; and therefore it stands in need of the same *Virtue* to continue to exist, as it had to begin to exist.

Moreover we clearly understand, that the *Soul* of *Man* is a *Thinking Substance*; that a *Body* consists of three Dimensions, and that *Man* is a compound of *Mind* and *Body*, without any *Existence*: Wherefore we ought not to ascribe to *Man* any *Power* whereby he can exist, and therefore he must be created by *God*, before he can exist. For every Effect we know is contained in its Cause, either formally or eminently, and seeing neither the *Soul*

nor the *Body*, nor *Man* that consists of both, can be the *Causes* of themselves, they cannot be contain'd in themselves as in their *Cause*; and therefore we must look out for a higher *Cause* that may eminently contain whatsoever is formally found in the *Creatures*; and that is that which we call *God*.

And forasmuch as the *Form*, according to *ARISTOTLE* gives *Being* to a thing, and *Concretes* are more perspicuously understood by their *Abstracts*; for a Confirmation of what we have said, it will be worth our enquiry what *Creation* is, and whether the name of *Creator* could be attributable to *God* from *Eternity*.

As to the first, the received Definition of *Creation* is, that it is the Production of a thing out of *Nothing*; Which may be admitted without Hesitation, if by *Nothing* we understand a Negation of all Reality, and not any thing Imaginary, which some do suppose to be that out of which all things are produc'd. For some do conceive this *Nothing* to be, as it were, a *matter* shut up in an Imaginary space, from whence all things do proceed. Wherefore, lest I should seem to favour their Error, I will take away all Ambiguity and define it thus, viz. That it is an operation, whereby things are produc'd by an efficient Cause, no other Cause concurring with it. So that a thing is said to be created, which besides *God* needs no other Cause towards its *Existence*. Where it appears that neither *Modes* nor *Accidents* are created, since they depend on the *Substance*, in which they are; and without which they cannot be conceived: As we have shewed in our *Logick*, in the Chapter of *Substance*.

A thing Created is that whose nature or *Essence* can clearly be understood without *Existence*. As the *Soul* of *Man*, of which we have a clear and distinct Notion, for as much as it is a *Thinking Substance*, abstracted from its *Existence*. And so likewise we have a distinct conception of a *Corporeal Substance*, as including three Dimensions, without considering its *Existence*: And therefore these must be Created by *God* before they can exist, and when they do so, must be preserved by his continual Influx.

It remains now to enquire whether *God*, could be call'd a *Creator* from *Eternity*, or whether the things created by him could have their Original before all *Time*. Before we can resolve this clearly, we are to take notice that before the *Creation* of the *World*, no *Time* can be understood by us, seeing that *Time* is nothing else but the measure of *Duration*; or to speak more clearly, is nothing else but a meer Mode of *Thinking*. For as the *Modes* of *Material things* serve for the easier explication of their *Natures*, so we make use of *Time* to express *Duration*, so that it is necessary that before *Time* could be, there must have been, not only *Creatures*, but *Men* also, that might compare the *Duration* of things *Existing*, with the *Duration* of other things, that had a determinate *Motion*. Now *Duration*, seeing it is not distinct from the *Existence* of things, save only by Reason, begins as soon as they began to exist, and ceaseth when they cease to be; because it supposeth them to be Created. Wherefore they who imagine *Duration* or *Time* before the first Production of things, are as deeply prejudic'd as those are who fancy an *Extension*

V. Abstracti-
ons do more
clearly ex-
plain the
nature of a
thing.

VI. What Crea-
tion is.

VII. What we
are to un-
derstand by
the Name
Creatures.

VIII. Before the
Creation of
the World
there was
no Time.

I. Some At-
tributes
agree to
God from
Eternity,
others in
Time.

II. Whatsoever
hath a Be-
ing, hath it
either from
it self, or
from ano-
ther.

III. Forasmuch
as the
Parts of
Time have
no necessary
connexion,
it follows
that Crea-
tures are
not preserv-
ed by
themselves.

IV. The Essences
of things
are clearly
known by
abstracting
them from
Existence.

sion of *Space*, without any Bodily Extension. To enquire therefore, whether a *Created thing* could be from Eternity, is as much as to demand whether there can be a *Duration* without any *Beginning*; and which cannot be expressed by any Number whatsoever.

IX.
God cannot
produce E-
ternal Du-
ration.

That such a *Duration* as this cannot be created by *God*, appears from hence, that no *Duration* can be mentioned, but that *God* is still able to produce a greater. For such is the *Nature* of *Duration*, that assign what *Duration* you please, a greater or lesser can still be conceived, seeing that it is, as it were composed of Parts, and always may be conceived as Divisible into them: For as there are no parts in a *Body*, altogether Indivisible; so neither are there any *Moments* in *Duration*, but may still be divided into lesser parts to Infinity.

X.
No Dura-
tion can be
understood
to be in
God.

Neither can we say, that because *God* hath been from Eternity, and is still, therefore we ought to attribute to him the greatest *Duration* that can possibly be conceived; for it is evident from what hath been already said, that no *Duration* consisting of Parts can be ascribed to *God*, but Eternity only, which is not an affection of *Existence*, but of *Essence*: And therefore that we cannot conceive any *Duration* in *God*, except we have a mind to destroy the *Idea* we have of him; forasmuch as it is essential to the notion of *Duration* that none can be conceived so great, but still greater may, which in no wise can be attributed to *God*, who is Infinite, and admits no Division of Parts.

XI.
Whether
God could
have Cre-
ated the
World from
Eternity.

You will say that *God* is as Powerful, whilst he acts freely, as if he did act necessarily, since liberty or necessity of acting, doth not alter the property of Power. But if *God* acts by necessity of *Nature*, he must have Created the *World* from Eternity, forasmuch as his *Power* is Infinite, and consequently it is no contradiction, that a *Creature* should be *Eternal*, that is, be produced without a *Beginning* of *Duration*.

XII.
Answer.

I Answer, that this *Argument* is deduced from a false *Hypothesis*, viz. that if *God* should act necessarily, he might for all that be of Infinite Power, which is very false; because it is the Property of a most perfect Being to act freely, which is so essential to it, that it can never be separated from its *Idea*: since there is but one only Being, that by us is conceived to be such.

XIII.
God can
produce still
greater and
greater Du-
ration.

Besides, it is the *Nature* of *Duration* that how great soever any is supposed, it may be still supposed greater; and therefore *God* who is of Infinite Power and a free Agent, may always produce a greater or lesser *Duration* than the supposed *Duration* is. But if *God* did act according to the necessity of *Nature*, no such *Duration* would be possible, because *God* acting necessarily, would only produce that which did follow from necessary Action; and consequently being unable to produce a greater, his Power would be Bounded, which is destructive of the *Idea* of *God*.

CHAP. XVI.

Concerning Gods Government of the World, and Providence.

I.
Supposing
God to be
All-know-
ing and
All-power-

From what hath been already said of the *Divine Attributes*, we may easily conclude that *God* is *Provident*, and the *Ruler* and *Governour* of all the *World*, and all things that are in it. For

seeing that he hath Created all things, and by his alone Power, brought them into a State of actual Existence, it seems to be Repugnant to his Goodness and Omnipotence, that he should neglect the care of them, and leave them to the Government and disposal of others. For since he is All-knowing, All-powerful, and supremely Good, he cannot but keep his Eye upon his Creatures, and govern and dispose of them for their good. For Will and Power, with respect to things without them, are not distinguished from the *Divine Understanding*; and since *God* hath decreed that at some certain time, *Creatures* should exist, he also determined them to exist so, as that their *Essence* and *Existence* might depend on his Will and Power, without being able to attain any Ends without his special Providence.

ful, he must
also be Pro-
vident.

By Providence, Divines understand that *Eternal disposal*, by which *God* doth Efficaciously direct all his *Creatures* to certain ends foreseen by him, so as that in time they come to attain them. For Providence doth not only denote the operation of the Intellect, by which a thing is foreseen before it be brought to pass; but also that of the Will, or the Decree and Counsel, whereby, before the work is done, it is disposed to the end appointed for it. And that such a Providence as this appertains to *God*, may be proved by several Reasons.

II.
What Pro-
vidence is.

For First, it belongs to the *Nature* of *God* to be most perfect; but how can he be said to be so, without being present to his *Creatures*, and taking care for them? For it is without doubt a greater perfection to provide for the Universe, and to govern and dispose all things for the best, than to leave them to themselves, or to be disposed of by others. For by so much the more perfect any one is, by how much the more he excels others in Command, Wisdom, Goodness and Liberality: But if the care of the *World* should be supposed taken away from *God*, we shall make him an Idle and Unactive Being, as EPICURUS doth; and by this means shall be able to conceive a more perfect Being, who together with the highest Felicity has the Sovereign command over, and disposeth of all things, and whose Tranquillity is not disturbed or interrupted by the Multiplicity of the Affairs he manageth. Wherefore, since nothing can be admitted to be more perfect than *God*, we must conclude, that he takes the care of, and disposeth all things. For it is not becoming, as DAMASCENUS saith, that there should be one Builder or Architect of this *World*, and another that takes Care of it, forasmuch as this would Argue a disability in them both; in the one of Making or Effecting, and in the other of taking Care for and Disposing of it.

III.
God would
not be the
most per-
fect Being
in case he
did not take
care of his
Creatures.

Secondly, Forasmuch as *God* is *Eternal*, having no Bounds of his *Existence*, it is necessary that his *Understanding* should be *Eternal* also, because it belongs to his *Essence* to be conceived by us as Supremely Intelligent: Now his *Understanding* is not distinguished from his Will or Decree, but only by Reason, or our meer Conception; therefore when we say that *God* understood, or knew all things from Eternity, we at the same time assert, that he also from Eternity provided for all things, and designed them to their appointed ends; seeing that his Will is Supremely Efficacious, and never fails of the ends he intends.

IV.
Gods Pro-
vidence is
proved
from his
Eternity.

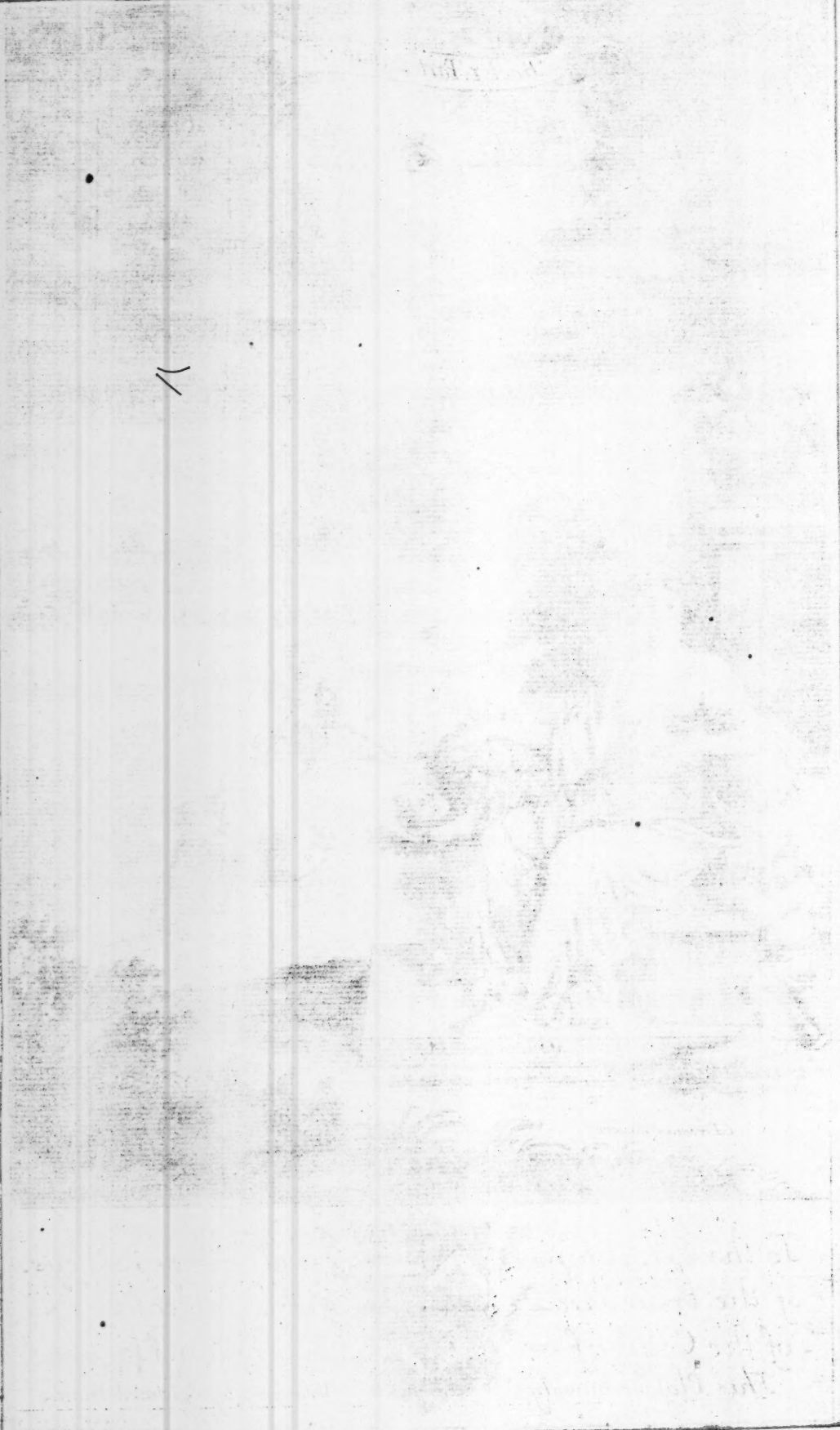
The



To the Worship-
of the Priory in
of the Citty of
This Plate is humbly



-full Jeffrey Jeffreys
Brecknockshire &
London. Esq.
Dedicated by Richard Blome



И
сп
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ре
С

V.
The same is
made out
from his
other At-
tributes.

The same may be confirmed from the rest of his *Attributes*: For if God be Sovereignly *Intelligent*, he must also be *most Wise*; and will not be accounted more *Wise* by governing the *World*, and administering all things, thereby not only *Speculatively*, but *Practically* understanding them? If God be *most Powerful*, he must be able to do all things, so as that nothing may be in a condition to resist his *Will*, or escape his *Power*. But how can this be, except he govern the things he hath produced, and concur to their *Actions*? If he be *most Good*, sure it is necessary that all *Creatures* experience his *Goodness*: But how can that be, if he takes no Care of them, nor Provides for them? Therefore we must own the *Divine Providence*; forasmuch as without it, his chiefest *Attributes* are destroyed, and nothing is left whereby we may demonstrate his Sovereign *Power*, *Wisdom* and *Goodness*.

VI.
God's Pro-
vidence,
and Go-
vernment
of the
World, may
be proved
from the
things
themselves.

Another *Argument* may be taken from the *Creatures* themselves. For whosoever considers the frame of this *World*, and the order of its *Parts*; whosoever takes a view of the *Earth*, the variety of its *Seasons*, the different *Shapes* of *Living Creatures*, the manifold *Virtues* of *Plants*; whosoever scans the *Fabrick* of the *Microcosm*, *MAN*, the multiplicity of his *Members*, with their admirable *Connexion* and *Harmony*: Whosoever takes a Prospect of the *Heavenly Bodies*, their *Lustre*, *Beauty*, constant *Motion* and *Proportion*, will be forced by his *Conscience* to acknowledge, that these *Wonders* could not be the product of *Chance* and *Fortune*, but the Effect of the Great *GOD*. And therefore *CICERO*, in his Book *de Natura Deorum*, speaks thus: *Shall we call him a Man, who beholding the certain Motion of the Heavens, the wonderful Order of the Stars, and all so fitly link'd and suited together; shall suppose that all this is manag'd without any reason, and by Chance; when indeed we can never have any Conceptions of the greatness of that Wisdom and Counsel which disposeth all these things?* When we see any thing moved by *Springs* and *Engins*, as a *Sphear* or *Watch*, have we any the least doubt of their being the Effects of *Reason*? and when we see the *Heavens* moving with admirable *Swiftnes*, and constantly to persist in their *Motions*, finishing their *Anniversary Revolutions*, for the *Health* and *Conservation* of all Things; shall we question whether these Things are order'd and directed by a most *Excellent* and *Divine Reason*?

VII.
How any
thing can
be said to
be by
Chance, if
all things
be rul'd by
Providence.

Tho' nobody that owns a *God*, can doubt of his *Providence*; yet this Difficulty remains to some, How any thing can be said to be by *Chance* in the *World*, if *God* governs all Things, and directs them to their certain *Ends*? And besides, How comes it to pass, that *God* taking Care of all things, his *Thunder* often spares the *Wicked*, and strikes the *Innocent*? Or, if every *Motion*, and all other things that keep their certain *Periods*, be called *Divine*, must we not also suppose *Tertian* and *Quartan Agues* to be such, whose *Motion* and *Returns* are so certain and constant?

VIII.
With re-
spect to
God, no-
thing hap-
pens by
Chance.

There is no question, but that many things happen by *Chance* in the *World*, with regard to *Second Causes*; but nothing at all with respect to the *First Cause*, who disposeth and fore-ordains all things from *Eternity*. For *Chance* and *Fortune* are only in respect of him, who is ignorant of the In-

tention of the *Director*: And forasmuch as the *Divine Intention* is hid from *Man*, till the thing be done; therefore the same, with respect to *Man*, is said to happen by *Chance*, but not with respect to the *First Cause*. How many things seem to happen in a *Commonwealth*, which with reference to us are *fortuitous*; but not so with respect to the *Prince* who governs it, who order'd things so on purpose, and made use of such *Ministers* and *Means*, so as that things could not happen otherwise? And whereas it is further objected, That sometimes *Thunderbolts* pass by the *Wicked*, and light upon the *Innocent*.

We are to consider, that all these things happen by *God's* particular *Direction*, for very good ends, which tho they be unknown to us, yet are not we therefore to deny them: For it is too great a piece of *Rashness*, to have so great an esteem for our own *Wit*, as that whenever we cannot find out the *True Cause* of any thing, we should presently suppose the *World* to be without a *Ruler*, and that the *Concerns* of *Men* are committed to the management of *Blind Chance*.

But you will say, If there be a *Cause* that presides over *Inferiour things*, why do we perceive such Confusion in the *World*? Why are the *Good* neglected and oppress'd by *Poverty*, *Slavery*, and *Dis-eases*; whilst in the mean time the *Wicked* flourish, and abound with *Honour* and *Riches*?

This is the *Complaint* of most *Men*, who being ignorant of the *True Good*, are taken with the outside of Things: For if we attend to the *Nature* of *Good*, we shall find that *Virtue* alone deserves that Name, which whosoever wants, is worthily esteem'd *Miserable*. Hence it is that *Wicked Men*, being devoid of *Virtue*, do not make use of those outward good things with that *Moderation* of *Mind* as they ought, but in the midst of their *Riches* suffer *Want*, and in the midst of their *Pleasures*, *Pain* and *Torment*; so that they are not *True* good things to them, but in appearance only. But on the other hand, *Evil things* happen to those that are *Good*, forasmuch as they are conducive to the exercise of their *Virtue*, they are rather to be accounted *Good things*, because by them their *Minds* are estranged from *Worldly Lusts*, and raised to the love and desire of *Heavenly things*. This therefore is the greatest Instance of *Providence*, when we see *Good things* bestowed upon *Ill Men*, that they may grow the worse; and *Evil things* upon *Good Men*, that thereby they may grow better.

But you will say, That *God* created *Angels* and *Men*, whom he foresaw would fall and continue in *Evil* or *Wickedness*. *St. AUSTIN* Answers, That *GOD* would not have created any *Angel* or *Man*, whom he foreknew would fall into *Sin*, if he had not known, at the same time, to what good *Ends* he could make use of them, and so compose the *Harmony* of this *Universe*, as a pleasant Song of *Discords* mix'd with *Concords*: For as these make the Sweetness of *Musick*, so the *Beauty* of this *World* is made up of these *Contraries*. And therefore in the *Third Book* of *Free-Will* he plainly teaches, That *GOD* ought not to have abstained from Creating of the *Creature*, whom he foresaw that by his own Fault (not by any of his *Creator*) should lose that *Beauty* in which he was created: For as a lost and wandering *Horse* is better than a *Stone*, which cannot wander, because it wants *sense* and *motion*.

IX.
How things
come to be
so turbu-
lently car-
ried in this
World.

X.
Why wick-
ed Men
prosper in
this World.

XI.
Answer.

XII.
Why God
Created
Men and
Angels,
whom he
foresaw
would be
corrupted
by Sin.

so that *Creature* is more Excellent, which *sins* by its Free-will, than that *Creature* which doth not *sin*; because it hath no *Free-will*. And as I would commend *Wine* as good in its kind, tho' I blame the Man that is made *drunk* by it, and yet would prefer this *drunken* and *blamed* Man before the *praised*

Wine that had made him *drunk*: So likewise a *Bodily Creature* is to be commended in its degree and kind, whereas they are *Blame-worthy*, who by the immoderate use thereof, are turned aside from the Perception of *Truth*.

The Third Part

OF THE

INSTITUTION

OF

PHILOSOPHY.

V I Z.

DÆMONOLOGY;

O R,

Of Intelligences and Created SPIRITS,

G E N I U S's and D Æ M O N S,

Commonly called

A N G E L S.

A Prefatory Discourse.

Of the Division of Created Things; the Definition of Pneumatics, or the Doctrin of Spirits, and its Certainty.

I.
The aim of
the Author
in this
Treatise.

NOwithstanding that to Treat of ANGELS does seem chiefly to belongs to *Divines*, and the consideration of their *Nature* and *Faculties* may be thought to exceed the Bounds of *Metaphysics*; yet I think it may not be useless to try what *Natural Light* can do in this case, and how far by the Guidance thereof, we may discover their *Essence*, *Existence*, and *Operations*.

II.
Division,
a great
Help to the
Knowledge
of Things.

They who endeavour to search into the *Nature* of *Things*, take care to divide them, as fitly as may be, into those Parts which may be helpful to the obtaining a more distinct Conception of them. For *Division* takes away the doubtfulness of *Terms*, and makes that which before was confusedly perceived under one Name or Word, to be more clearly

understood by more Words, expressing the Parts of it.

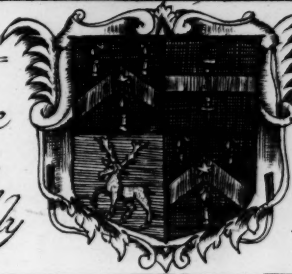
It is notorious to all *Philosophers*, that *Created Things* are divided into *Spiritual* and *Corporeal*, or into *Thinking* and *Extended*. By the Name *BODY*, all *Material* or *Extended Substances* are understood, of what *Nature* soever they be, whether they be more *Gross* or *Subtil*; whose *Essence* consists of three *Dimensions*, or in *Extension* in *Length*, *Breadth*, and *Depth*. And we call that an *Incorporeal Substance*, or *Immaterial*, which is without *Extension*, and all those *Modes* and *Accidents* which accompany a *Bodily Substance*. Whence it appears, how very improperly the Name of *SPIRIT* is attributed to the *Air*, *Wind*, *Fire*, *Vapor*, &c. because tho' these *Things* be more *Thin* and *Subtil* than others, yet don't they for all that cease to be *material*, *impenetrable*, and *indefinitely divisible*.

III.
The Division of Substance into Thinking and Extended.

We



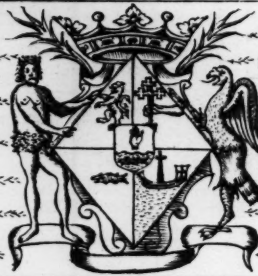
To the Worship-
of Llywell. in the
and of the Citty
(This Plate is humbly



full John Jeffreys
County of Brecknock
of London Esq.
Dedicated by Rich. Blome



To the most Honourable
of Antrim, relict of the
Donnald, Marquiss and
Dunluce; and sole
S^r. Henry O'Neill of
County of Antrim in the
This Plate is humbly



Rose Marchioness Dowager
most Honourable Randall m.
Earle of Antrim, Viscount
daughter and Heyress of
Edenduf = Carick in the
Kingdome of Ireland &c.
Dedicated by Richard Blome

IV.
Quantity
cannot be
attributed
to Angels

We may also perceive with how little Reason some do attribute Quantity to *Angels* and *Human Souls*, and conceive one part of them to be without another, as if they were *Material*. Whereas if a *Man* consider a *Corporeal* and *Intellectual Substance*, he will find them to be distinguished by Properties and Attributes, and to have no affinity at all with each other. For what Similitude can there be supposed between a *thing extended*, and a *Being* devoid of all *Extension*? Or what agreement is there, between a *Substance* that *understands, wills, and imagines*, and that which is divisible into parts, and is diversified by *Figures*, and which is commensurate to a certain space and Place?

V.
Substance
is wrongly
divided by
some into
immaterial
and Bodily.

Others divide *created substance* into *Immaterial* and *Corporeal*; but this Division doth not seem to be exact, or made according to the Rules of a right Division: because *Immaterial* and *Incorporeal* being *Negative Terms*, can represent no positive *Idea* to our *Mind*, such as is desired by all, where it may be had. For *Negative Words* represent no Properties or Attributes to our perception, and rather tell us what the thing is not, than what it is. True it is, that this Division is set down by many *Philosophers* of great note: but forasmuch as a Privative or Contradictory opposition (which those words do import) cannot have place in a lawful Division, this is not to be admitted. Moreover this Division seems to be grounded on this Childish mistake, that the *Substance* of *Material things* is more real, than that of *Spiritual*; and that therefore the former, as more perfect, are expressed by *Positive* words, but the latter, as more Imperfect, by *Negative*.

VI.
Is better
divided in-
to Thinking
and Ex-
tended.

Wherefore *Created Substance* is more fitly divided into *Thinking* and *extended*, or into *Intellectual* and *Corporeal*; because then the Dividing parts, are apprehended by Positive conceptions, and expressed by *Positive Terms*. For without doubt, we shall have a more clear notion of an *Angel* by conceiving him *Intelligent, Willing and Powerful*, than by apprehending him *Immaterial, Incorporeal and Invisible*: Forasmuch as these *Negative Attributes*, as I said, rather declare what an *Angel* is not, than what he is. Besides, he that perceives the Positive Properties of a *thing*, does by consequence understand the *Negative*; but not on the contrary: For he that knows an *Angel* to be *Intelligent*, doth at the same time know him to be *Incorporeal* and *Invisible*; but tho' he understand him to be *Incorporeal* and *Invisible*, he does not therefore understand him to be *Intelligent*; for the *Air* is *Invisible*, and yet is neither *Intelligent* nor *Incorporeal*. Wherefore *created Beings* are very properly divided into *Intellectual* and *Corporeal* or *Material*, for no substance can be conceived by us, which is not either *Thinking* or *Extended*, or in other words, which is not *Active* or *Passive*. Hence St. AUSTIN saith, *Amongst things, some thing is acted, and not Acting, as a Body; another is Acting, and not Acted, as is God; and a third Acting and Acted, as are all Spiritual Substances.*

VII.
The Distri-
bution of
Science
Universally
consider'd.

As all *created substance* is divided into *Material* and *Intellectual*, so the knowledge of that *Substance* is distinguished into *SOMATICA*, or the Science of *Bodies*, and *PNEUMATICA*, or the Science of *Spirits*: Which may again be subdivided into other *Species*, according to the various no-

tions under which a *Body* or *Spirit* may be considered. For as a *Body* is conceived by us, either as *Natural*, or as *Artificial*, or as having *Quantity*, and being *Figur'd*, or as subject to *Sickness* and recoverable; so accordingly divers *Species* of *Sciences* are constituted. *Natural Philosophy* considers a *Body* as *Natural*, and explains its *Essence* and *Properties*. *Mechanical Science* Minds the outward frame and structure of the *Body*, and the figures it obtains by workmanship and Art. *Mathematicks* take to task the various *Modes* of a *Body*, as the figures which bound it; the situation of one part with reference to others; the *Motion* or change of situation; and *Rest* or continuance in one place: Lastly, *Physick* or *Medicine* considers the *Body* as subject to *Diseases* and *recovery*, and endeavours to maintain the health, or to restore it when lost.

In like manner as *Intellectual Substances* are divided into *God, Angels, and the Souls of Men*; so *Pneumatica* is divided according to the Diversity of the objects it contemplates into *Natural Theology, Geniography* or the science of *Angels*, and *Psychology*, or the Doctrine of the *Soul*. *Natural Theology* considers the *Essence* of *God* and his Attributes; *Geniography* the nature of *Angels* and *Intelligences*; and *Psychology* examines the constitution of the *Mind* of *Man*, its Faculties and Passions. So that *Pneumatica* is nothing else but the science of *Spirits*, which admits of divers names, as it considers *God, the Angels, or the Soul of Man*.

VIII.
The Divi-
sion of
Pneuma-
tica, or the
Science of
Spirits.

The certainty of this science is very clear from its Definition, because it treats of *Incorporeal things*, and such as are not subject to change: For if *Natural Philosophy* which treats of a *Natural Body*, and *Mathematicks* which handles the *Modes* that follow it, deserve the name of *Science*, because they are founded on *Axioms of Eternal Truth*, much more doth the *Doctrine of Spirits* deserve the name of *True Science*, forasmuch as it is not only grounded on *General Propositions*, but likewise borrows its certainty from the Object it considers, and deduceth clearer Conclusions thence, than *Natural Philosophy* doth from a *Body* or *extended Substance*. For tho' the vulgar sort of *Mankind* is apt to be mistaken, and doubtful about *Immaterial Substances*, whether they do really exist, and think that the name of *Thing* ought only to be attributed to *Bodies*; yet the *Lovers of Wisdom* do own *Thinking substances*, to be much truer, and much more real than any *Bodily* or *Material Beings*.

IX.
The cer-
tainty of
the Science
of Spirits.

CHAP. I.

Of the Nature of Angels.

THE Division of *created Substance* into *Thinking* and *Extended* being supposed, it will not be difficult to conceive what a *Spirit* is, and how it is to be distinguished from other things. For the Word *Spirit* is here to be taken in its most proper sense, for such a substance as is endued with the Faculty of *perceiving* and *willing*. Because as the formal Reason of a *Body* consists in *Extension*, which is always attended with *Divisibility* and *Impenetrability*; so the essence of a *Spirit* consists in this that it is a *Thinking Substance*, the concomitants whereof are *Indivisibility, Perception* and *Volition*. And as a *Body* cannot be conceived without

I.
What we
are to un-
derstand by
the Name
of Spirit.

Extension, so neither can a *Spiritual Substance* without *Cogitation*: And therefore it is necessary that *Cogitation* do constitute a *Spirit* in its *Spiritual Nature*, as *Extension* constitutes a *Body* in its sensible and divisible Nature. Forasmuch as according to *ARISTOTLE*, that is suppos'd to belong to the *Essence* of any thing, *without which* it cannot be understood.

II.
Some think
there is no
Substance
but what is
Material.

And whereas some suppose they cannot conceive an *Angel* without *Extension*, and so confound the Notion of *Substance* with that of *Extension*; this proceeds only from a false prejudice they have entertained, viz. that there is nothing *Intelligible*, but what is likewise *Imaginable*, which certainly is a very great mistake; for *Angels* and all other *Spiritual Substances*, cannot be reached by our *Imagination*, but only by our *Intellect*. For all Men generally take an *Extended Being*, to be somewhat *Imaginable*, in which there are various parts of a determinate *Magnitude* and *Figure*, and whereof the one is not the other; which Notion in no wise can agree with *Spirits*.

III.
Spirit is a
general
name to
Angels and
Demons.

By the Name *Spirit*, therefore we are here to understand a *Finite Thinking Substance*, altogether independent on, and free from *Matter*: Under, which *Angels*, *Demons* and *Intelligences* are comprehended; neither is there any Distinction between them, save only that the *Angels* are Good, and the *Devils* Evil; that these aim at the Destruction of *Mankind*, the other assist their Salvation; these abide in *Sin*, the others continue in *Grace*; these are bound in *Hell*, the other enjoy the Vision of *God* in *Heaven*: All other things, as *Essence*, *Existence*, *Knowledge*, *Power*, the taking up of *Bodies*, *Talking together*, &c. being common to them both.

IV.
The Angels
are Imma-
terial Sub-
stances.

From the Definition of a *Spirit* or *Immaterial Substance*, we may with great Evidence conclude, that *Angels* are *Pure Spirits*, or as *DIONYSIUS* in his fourth Book concerning *Divine Names*, saith, *Free from Matter*, and *Incorporeal*. Because a *Thinking* and an *Extended Substance*, are altogether distinct from each other, so that the one of them can be clearly perceived without the other. For we most clearly perceive a *Spirit* or *Thinking Substance* without a *Body*; and on the contrary, a *Body* without a *Spirit*. Now things that are thus distinguished, cannot agree to one and the same Subject: Because these *Attributes* are altogether different; and there can be no greater opposition between *Attributes* of *Substance*, than *Diversity*. And therefore to say, that *Extension* and *Cogitation* agree to one and the same Subject, is in effect to affirm, that one and the same Subject can have two *Natures* or *Essences*, which cannot be said of a Simple thing without a Contradiction. Because *Cogitation* and *Extension* are not only two *Essential Attributes*, but also constitute the nature of the thing to which they are attributed, and are more inconsistent, than *Blackness* and *Whiteness*, *Heat* and *Cold*, in the same Subject. For *Heat* and *Cold* may succeed one another in the same Subject, and the same thing which is *Cold* now, may afterward become *Hot*: But it is altogether Contradictory that *Cogitation* and *Extension* should be in the same simple Subject, and constitute two *Natures* at once, or Successively.

V.
Forasmuch
as Angels

Moreover, if *Angels* were *Material*, they might be divided; for *Divisibility* is a Concomitant of

Extension; but *Angels* are not *Divisible*, therefore they are not *Corporeal* or *Extended*. The *Minor* is thus proved: The *Essence* of an *Angel* consists in *Cogitation*, which admits of no Division; or no body can conceive the half of a *Thinking Being*; wherefore *Angels* are exempt from *matter*, and from any *Corporeity*, how subtil soever the same may be conceived.

are Indivisible, they are likewise Incorporeal.

The *Immateriality* of *Angels* may be made out from some *Effects* that exceed all *Human Power*, and the utmost activity of *Bodily force*: Such as are the *Antient Idol Oracles*; the *Speech* of *PEOPLE POSSEST*, which are often in those *Languages*, which the possessed party does not understand; the *Penetration of Bodies*, and such like, which are an incontestable proof of *Intelligent Natures*, and which exert their Activity without the help of any *Body*. Besides we Read in *Scripture* that a vast multitude of *Devils* entred one *Body*, *Mark 5*. yea, a whole *Legion*, which according to the most common Account contains 6666, which is absolutely impossible, if the *Devils* have *Bodies* and take up a determinate place.

VI.
The effects
of Angels
proves
their Incor-
poreity.

They who assert *Angels* to be *Compound Beings*, and to have *Bodies*, tho' much purer, and of a more subtil *matter* than ours, endeavour to confirm their Opinion from *Gen. 6*. where it is said, that the *Sons of God* came in unto the *Daughters of Men*, and they bare Children to them, and the same were *Mighty Men* or *Giants*. Which could not be, except we suppose the *Angels* to have *Bodies*; *Spirits*, as purely such, being incapable of Generation.

VII.
Whether
Angels be
capable of
Generation.

But this place is wrongly interpreted; for by the *Sons of God* in that place we are not to understand *Angels*, but the Posterity of *Seth*, who imitating the Pious conduct of *Enos*, did worship *God*, and call upon his Name; but their Posterity degenerating from the Piety of their *Fore-fathers*, and plunging themselves into *Carnal Concupiscence*, joyned themselves with the *Daughters of Men*, that is, with *Cain's* Posterity; from which Conjunction *Giants* were born, that is, monstrous and deformed *Bodies*, as a Punishment of their Lust. For it is contrary to Reason to suppose, that *Angels* can Generate. Wherefore, the *Fathers* of these *Giants* were not *Angels*, but *Men*, as the *Scripture* sufficiently declares, *Gen. 6. 3*. *My Spirit shall not always strive with Man, for that he is Flesh*.

VIII.
What we
are to un-
derstand
by the Sons
of God in
Scripture.

But will some say, if the *Angels* be altogether exempt from Composition, and any *Matter* whatsoever, they will be as Simple as *God* himself, as being the one as well as the other *Pure Spirits*, having only an *Essence*, and some *Modes*, which do not hinder Simplicity.

IX.
Objection
that the
Angels will
be equal to
God in the
Simplicity
of their
Natures.

To which I Answer, that tho' neither in *God*, nor the *Angels* there be any Composition of *Matter* and a *Substantial Form*, yet are not the *Angels* exempt from all other Composition, as consisting of Potentiality and Act, of *Essence* and *Existence*: Which Composition is not to be found in *God*, forasmuch as the *Divine Modes* are only distinguished by Reason (that is, our way of Understanding) from the *Essence* of *God*. Wherefore the *School-men* call *Angels* and *Souls* *Impure*, and *Imperfect Acts*, but *God* the most *Pure* and *perfect Act*. Hence it is that *DESCARTES* in the 23 Article of the first Book of his *Principles*, Teacheth, that our *Mind* (and the same is to be understood of *Angels*) doth

X.
The Sim-
plicity that is
in God is
very differ-
ent from
the Sim-
plicity which
is in Angels

doth understand, and will, by Operations, that are in a manner distinct; whereas, God by one and the same most Simple Operation, doth Understand, Will and Act,

XI.
Angels do not understand all things actually.

Besides, Angels have not actually all the Cogitations they can have, seeing that many things can be Revealed to them by God, and we understand them to have many Thoughts potentially only; so that at the same moment of time, they are conceived as Thinking in part Actually, and in part Potentially. Which is sufficient to denominate them Compounded, and excludes them from the Simplicity which is in God.

CHAP. II.

Whether the Existence of Angels be demonstrable by the Light of Nature, and how the same may be Evinc'd.

I.
The Antient Philosophers believed Angels.

IT was the constant Opinion of the Antient Philosophers, that there were Demons and Genii or Intellectual Substances, which did preside over the things of this World, and were the managers of Heavenly things also, as so many Divine Ministers. For they thought it not befitting the Majesty of God, to Administer the World by himself, but that he made use of Ministers and Servants, in the discharging of so many different Offices. For should God be thought inferiour to the King of Persia, who residing at Susa or Hispahan, Govern'd his large extended Empire, and by the Hands and Heads of others, was every where present with his Subjects, provided for them, and defended them? Seeing therefore that God hath his Ministers, they must needs be Spirits, that is, most active and ready to expedite his Commands: But how can they be such, if they be clog'd with the weight and cumber of a Body? Whence they conclude, that there are Angels, which are call'd Genii, forasmuch as they assist Men; and Demons as they are the Administrators of this lower World; this is confirmed by a Verse quoted by CLEMENS ALEXANDRINUS, and ascribed to ORPHEUS.

Standing about thy Throne the Angels are,
Who of Mankind do take the Active Care.

II.
God can govern the World by himself.

By this way of Arguing it appears, that the Antient Philosophers did believe Angels, tho' it does not prove that they really Exist; forasmuch as all those things, which they commit to the care and management of Genii and Demons, may be done by God alone. Neither indeed is it unbecoming the Divine Majesty, by his own Power to provide for his Creatures, without the assistance of any Ministers, to share in the Burthen of the Government: For God being Omniscient and Omnipotent, always chuseth that which is best, and therefore does not stand in need of any Angelical Assistance, in the Execution of his designs. And if there be any Intelligences in the World, that perform his Commands, that is because God thinks it best, and most conducing to that State of the World, which in his Wisdom he hath allotted it, that so the Universe should be a kind of Commonwealth, wherein He as Lord paramount, should Govern and Administer all things, especially the concerns of his Rational Creatures by the Mediation of Angels, as subordinate Magistrates under him.

III.
The Existence of

Neither indeed is it so easie a matter, to prove the Existence of Angels by the Light of Nature

only; because tho' we have a clear and distinct perception of Spiritual things, as they are Thinking Beings, and distinguished from things extended; yet forasmuch as their Existence is only Possible and Contingent, all that we can infer from thence is only thus much, That Angels may Exist, but not that they do really so. For if the Existence of Angels could be demonstrated, it must be by an Argument à Priori, when we demonstrate any thing by its nearest Efficient Cause; but so we cannot prove, that God the Maker of all things hath Actually Created Angels, since Creation depends on the meer Good Pleasure of God, which cannot be known to any without a Special Revelation.

Angels cannot be demonstrated à Priori.

Wherefore we can have no certainty of the Existence of Angels, save only from their Effects, or other signs that argue their presence. Thus we may prove, that there are Angels, from Persons Possessed, who tho' they be altogether Ignorant and Illiterate, do notwithstanding Speak strange Languages, and Discourse of several things beyond their Capacity; declare what is done by Persons far absent, and are carried through the Air, notwithstanding the weight of their Bodies. Who can deny, but that all these things must be performed by Spirits, since they Transcend the Activity of Bodies, and the Power of Nature?

IV.
The Existence of Angels proved from their effects.

The Existence of Angels is confirm'd by the Answers of Idols, and the Predictions of Soothsayers, and those unwonted Motions, the Cause whereof cannot be assigned, unless we should say, that they are produced by such Invisible Agents. For we must not say, as some do, that these Effects may be produced by the First Cause; because God never Thwarts himself, nor does any thing Derogatory to his Glory, as are the Idol Oracles, and things done by Persons that are Possessed.

V.
Soothsayers and Oracles prove the Existence of Demons.

It is a received Axiom amongst the Antient Philosophers, That a Body cannot move it self, or that whatsoever is moved, is moved by another: Wherefore there must be allowed some Active Principle, that may move Matter. For evident Motions must have a Cause, which cannot be Coporeal; for so the Question would return, By what Principle that was moved, and so to Infinity, till we come to some Immaterial Cause. Hence it is, that ARISTOTLE and other Philosophers hold, That Intelligences move the Heavenly Bodies: And consequently, that the Superior Bodies communicate no other Motion to Inferiors, but what they have first received from the Angels.

VI.
From the inactivity of Matter, we may infer, there must be Spirits to move it.

Neither do we want very probable Conjectures of the Existence of Angels, if we consider the Harmony and Order of the World, and how its extream Parts are linked together, by Intervening Middle Parts. For since we see some things in the World, that are Compounded of a Thinking and Extended Substance, as Man, who consists of Soul and Body; it seems very Rational, that as there are things that are altogether Bodily, or that include nothing but Extension; so on the other hand there should be Spiritual Substances, whose Idea involves nothing but Cogitation.

VII.
Reason convinceth us of the Existence of Spiritual Substances.

This may be confirmed from divers Apparitions of Angels mentioned in Holy Scripture, which happened in divers Places and Times: Thus, they appeared to Jacob as he was on his Journey, Gen. 32. To Zachary in the Temple, Luke 1. To Guidon in his Fathers Ground, Judg. 6. To our Saviour in the Garden,

VIII.
Apparitions of Angels.

Garden, Luke 22. To the Childeren in the Fiery Furnace, Dan. 3. In the Prison to Peter, Acts 12. At our Lords Sepulcher, Mat. 28. In the Wildernes to Hagar, Gen. 21.

CHAP. III.

Of the Faculties of Angels, and first of their Understanding, and its Object.

I. A thinking Nature hath two Faculties.

Intellectual Nature hath two Faculties, Understanding and Will, which are as it were its Properties, and inseparable from it. The first of these perceives Objects by contemplating the Notions, it finds in it self; the other determines an Intelligent Being, to the embracing or avoided of a thing, or to suspend its Judgment, where the thing is not sufficiently understood. And forasmuch as these Faculties are distinguished at least by Reason, and are variously conversant about their Objects, we will also separately handle them, speaking first of the Understanding, and afterwards of the Will. Because it will conduce much to the discovery of the nature of Angels to know how far their Knowledge and Wills do extend.

II. The Various objects of Angelical knowledge.

As to the Object of Angelical Understanding, the Schoolmen dispute, First, whether Angels and Devils do understand the mysteries of grace by their natural ability. Secondly, whether they know the Thoughts of men, and can penetrate the secrets of their Hearts. Thirdly, whether they know Future things. The First Question I leave for Divines to determine, contenting my self to speak a few words to the two latter, which do not exceed the Bounds of Philosophy.

III. The Common opinion of Schoolmen concerning the knowledge of Angels.

As to the second Question, viz. whether Angels know Mens thoughts? the common Opinion is that Angels and Devils cannot naturally know the Thoughts of Men without their consent. The Cause of this hiddenness of Mens Thoughts, some ascribe to the Free Will of Man; others to the Abyss of Mans Heart; others to the Will of God, who denies his Concourse to the knowing of them; others to the nature of Mens thoughts, which cannot objectively occur to others without the Will of him that thinks them.

IV. The common opinion refused.

But indeed all these Reasons are very weak, and do not at all prove that the Thoughts of Men are inscrutable by Angels; because the Perceptions and Determinations of Mans Mind, are in themselves no less Natural, than the very nature of Angels: And therefore as an Angel beholds his own thoughts, there seems no Reason, why they should not as well perceive those of other Angels and Men, seeing they agree in Substance. Besides, it cannot be doubted but the Angels understand their own thoughts, and those of others too, with their consent: But the Identity or Sameness of subject, or anothers consent, doth not encrease the Faculty, or communicate any perfection to it, or render the understanding Faculty more proportionate to its Object; wherefore if Angels by the consent of another can penetrate his thoughts, they may as well without it. Neither is it any objection against this, that humane Actions are free, and depend on their Wills, because all the forementioned difficulties recur also upon this: And this only seems deducible from it, that Angels know such Acts as these to be free, and like to those they themselves produce. But who will say that Elicit Acts

have such a dependence on the will that they cannot be known by another, without the consent of him that Elicits them, seeing there is no difference between Acts that are free, and such as are not free; and that the same Act may successively change its nature, and of Free become Necessary? Wherefore I think we may conclude, that as Angels can know Acts that are not free, so likewise may they those that are free.

Wherefore let this stand fast, that Angels can perceive the Thoughts of Men: For seeing that Angels are Intellectual Substances, and that the Perception of the Understanding and Determination of the will, are the operations of Intellectual Faculties, there must needs be a Proportion between them. Besides, there are but few determinations of our will, which are not discovered by some signs, as by the motion of Spirits about the Heart, or by some outward tokens, which may give an occasion to Angels and Devils to discover the Thoughts and Affections of the Heart. But if all those signs were taken away, yet there is such an Agreement or Correspondence betwixt the Operations of the Mind, that they cannot but naturally perceive the Conceptions of our Understandings, and Decrees of our Wills. I my self some few years since heard a Devil speaking out of a possessed Woman at Brussels, who revealed the inward thoughts of many that came to her, tho' they were not discoverable by any sign. And when one of the standers by asked the Spirit, What it was he thought of at that instant? He told him that he resolv'd to take a Journey the next day, which he could not deny, but it was so. Neither needs this seem strange to us, seeing that we our selves would know as much if we were not shut up in these Bodies; and therefore are our thoughts hidden from others, because the Eyes of Men cannot pierce into our Breasts, which by reason of their materiality, are impenetrable. And it is probable that when some of the Holy Fathers deny'd the knowledge of Mens thoughts to Angels, it was for no other reason, but because they held them to be material.

V. That Angels do penetrate the secrets of Mans Heart.

If you say that this Opinion seems contrary to Scripture, I. Kings 8. 29. ver. For thou only knowest the Hearts of all the Children of Men. And Jerem 17. ver. 9. The Heart is deceitful above all things, and desperately wicked, who can know it? The Lord search the Heart and try the Reins. In which places by the Heart are meant the secret thoughts, and whatsoever immediately depends on the Mind.

VI. An objection from Scripture.

This Objection is easily answer'd by saying, that the Scripture in these places doth distinguish God from Men, with respect to the knowledge of thoughts, but not from Angels and Devils. And whereas Holy Writ seems to attribute this Priviledg to God only, not to Angels; this is, because it considers the Angels as Gods Ministers, and therefore ascribes to God whatsoever is done, or perceiv'd by them.

VII. Answer.

As to the Third Question, whether Angels know things to come? We are to suppose that this is not to be understood of a knowledge of Futurities that may be gather'd by conjecture from probable Causes; as a Master of a Ship foresees a Tempest, or a Physician the probable Event or Issue of a Disease; or a General the Event of a Battle; but of the Knowledge

VIII. By the knowledge of Future things, we are not to understand that which is gathered by conjectures.

Chap. IV.

Of Demonology.

Knowledge of things that are meerly Fortuitous and Contingent, which have no causes, or which are the effects of *Mans free will*; as that *John* will be kill'd by a Tile falling from a *House*; or that *Peter* is to take a Journey to morrow.

IX.
Angels naturally cannot foreknow future things.

I say therefore that neither *Angels* nor *Devils* do foreknow future Contingencies, which either have no certain *Causes*, or depend on Free will. The *Reason* is because an *Effect* must be known either in it self, or in its cause; but these *Futurities* cannot be known either way, and therefore cannot be known by *Angels*. That they cannot be known in themselves is evident, because they are not determin'd, neither have any necessity of existing; nor in their *Cause*, for that is free, either to produce or not to produce an effect. This may be further confirm'd thus; *Angels* are ignorant what themselves shall act, before they have resolv'd it with themselves, and therefore much less do they know what others will do. And therefore some *Schoolmen* are of Opinion, that the *Devils* did not foreknow their *Fall*, nor the *Miseries* consequent upon their *Sin*.

X.
They may probably conjecture of things.

Yet it cannot be deny'd but that *Angels* and *Devils* may know many things by conjecture; since they can have a great insight into the *Temper* and *Propensity* of *men*, by knowing their *Manners*, and discerning the resolutions and thoughts of their mind by external signs and tokens.

CHAP. IV.

Of the Will of Angels.

I
What the Will is, and whether it be found in Angels.

THE Will is here taken for that Power or Faculty whereby an Intellectual Nature produceth all its actions and thoughts that are of choice and determination, from himself without any force or compulsion. For it is the nature of a *Thinking Being*, that consider'd in it self, it can do something, and determine it self to *Act* or not to *Act*. Now this determination proceeds either from the things themselves, without the Intellectual nature, or from the Intellectual nature it self. The *Actions* which have no other *Principle*, besides the Thing that *Thinks*, are called *Volitions*; and the Intellectual nature as it is to be consider'd to be an *Elective Faculty*, and a sufficient *Principle* to produce such *Actions*, is called *Will*. Now, that such a will is to be found in *Angels* cannot be question'd, forasmuch as they are *Thinking Substances*, or *Beings* that of their own nature have a Power of *Willing* and *Nilling*.

II.
Two Doubts about the Will of Angels.

Concerning the will of *Angels* it may be enquired, First, whether this *Active Power* in them be free, and without force, from any thing that is *External*: Secondly, whether the *Angels* have such a power over their *Thoughts*, that they can cease from all *Perception* and *Judgment*.

III.
The Will of Angels is free.

As to the First it seems certain, that the Will of *Angels* is free, and cannot be forc'd by any Agent to do any thing, or leave it undone; because the Nature of the Will consists in its being free, so that it implies a contradiction for it to be forced by any *External Agent*, since no Agent can destroy the Nature of another, which would then be, if the Will should will any thing with reluctance. Besides, the original of this Freedom comes from hence, that it is the very *Angel* himself, that determines himself, and wills this thing or the other; so that it depends on his own meer

Will, that he freely Wills or Nills. Moreover, The Will, and Free Will, if well look'd into, are one and the same thing, and differ only in this, that the Will is understood to be the Chusing or Elective Power, by which a *Cogitative Being* doth determine it self, and perform all his *Motions* and *Actions* that proceed from the said Will: And by Free Will, we understand the same Faculty, but much as it hath the Power of Chusing. Now since both these are found in the *Angels*, they must by consequence also have Free Will.

IV.
An Objection against the Liberty of Angels.

If you Object, That the *Angels* do infallibly follow and embrace the Good they know; and that therefore *Divines* say, That they Love GOD for as not to be able to turn their Love from him: Because by *Grace* they are so united to God, that they cannot be separated from him, and are so satiated with the *Divine Glory*, that they cannot be drawn from the Enjoyment of so great a Good.

V.
The Objection Answer'd.

I Answer, That notwithstanding all this, the *Angels* still continue Free, and Love God freely; because the Essence of Liberty doth not consist in Indifferency, but in the free determination of the Will, by which an *Angel*, or the Mind of *Man*, is so carried towards that which is propounded to it by the Understanding, either in Affirming or Denying, Embracing or Avoiding, as not to be determin'd thereto by any outward force. For the Indifferency of the Will only then takes place, when there are no Reasons to sway the Mind one way more than the other; which State is the lowest Degree of Liberty, and argues no Perfection in it, but only a Defect in its Knowledge. For who can deny, That *Man* doth nothing more voluntarily, than those things in which he finds not the least cause of Doubting? Wherefore *Des Cartes* concludes in his 4th Mediation, That *Divine Grace*, or *Natural Inclination*, do never diminish *Man's Liberty*, but rather increase and strengthen it; and that a *Man* ought to be accounted so much the more Free, by how much the more he is byass'd one way; either because of his clear discerning of the Goodness and Truth that is in it, or because God so disposeth his Thoughts. Wherefore, when the *Angels* do inseparably adhere to God, and are link'd to him by stable Eternity, as *Divines* express it, they do not by this means lose their Liberty, but by *Grace* are inclined to one part; and tho' indeed their Indifferency be diminished, yet their Liberty is rather increased, since to act Freely, and to act Voluntarily, are one and the same thing.

VI.
Liberty may be consider'd in two ways.

The Matter will be more evident, if we consider the Liberty of Voluntary Actions, either before, or in the same moment they are exerted: If the Actions of the Will be considered before they be exerted, there is no question, but that the *Angels* have power to determine themselves to one or the other Contrary, that is, to prosecute or avoid one and the same thing. Yea, according to some *Divines*, the *Angels*, whether Good or Evil, daily change their Wills. The latter, when they surcease their Temptations, finding that they are of advantage, rather than any hurt or hindrance to good Men. The former, when they forsake the Wicked, whom they find they cannot reclaim from their Impiety. But if we consider Liberty in Voluntary Actions the same Moment they are exerted,

to it contains no *Indifferency*, in what sense soever it be taken; whether for that State wherein the *Will* is not prompted to embrace one thing rather than the other, by any knowledge of the *Truth*, or *Goodness* of them; or whether it be taken for that *Positive Faculty* of *Intellectual Nature*, whereby it can chuse, which it pleaseth of two Contraries. Because that which is a doing, cannot but be a doing at the same time it is a doing. And the *Liberty* which *Angels* have is such, as according to the increase of their Faculty of *Acting*, as was said before, is increased and strengthened.

VII.
The Angelical Will is not determin'd to one Action.

As to the Second Doubt, *Whether the Will of Angels be determin'd to elicit any Action; or whether it can at its pleasure omit the same, and be void of all Thoughts?* I Answer, That the *Will* of *Angels* is not ty'd to any certain *Action*, as being *Indifferent* of its own Nature, and not bound to any certain Knowledge, since they neither love themselves, nor God necessarily, as their Natural End. Yet they cannot at their pleasure rid themselves of all manner of *Thoughts*, as some think they may, because it is the Nature of a *Spiritual Substance* to *Think* always; and therefore it implies a Contradiction, for an *Intellectual Creature* to be without all *Thoughts*, seeing we understand nothing else by the Name of *Spirit*, but a *Thinking Being*.

VIII.
An Angel Thinks, whilst he commands himself to cease from Thinking.

If any one urges, That an *Angel* may abstain from all *Thoughts*, by commanding his Understanding to leave *Thinking*. I Answer, That this very Command or Will not to *Think*, cannot be exerted by an *Angel* without his being conscious to it, and consequently without his *Thinking*. For to *Will* is as much a *Thought* as to *Will*; wherefore *Angels* cannot cease from all *Thoughts*.

CHAP. V.

Concerning the Power of Angels, as to the moving and producing of Bodies.

I.
There is a Faculty in Angels, to move Bodies.

BESIDES the Operations of the *Will*, mention'd in the foregoing Chapter, there is another whereby a *Spirit* doth move a *Body*, and acts upon another *Spirit* like it self. For this Faculty is so intimate to a *Spirit*, that it cannot be conceived without it. We may indeed understand a *Spiritual Substance*, without the Power of Moving a *Body*, or of acting on another *Spirit*, in the same manner as we may understand a *Spirit* without the Faculty of Perceiving or *Willing*, which are two Modes of *Thinking*: But we cannot understand a Faculty of Moving it self, or from its own strength, without a *Thinking Substance*. And therefore we rightly conclude, That the Faculty of Moving a *Body*, and Acting upon a *Spirit*, do belong to *Intellectual Nature*, and is one Mode of *Thinking*.

II.
The Point confirmed by Examples fetch'd from Scripture.

That this Power is in *Angels*, seems unquestionable; forasmuch as *Holy Scripture* doth witness, that several *Bodies* have been translated from one place to another by the Help of *Devils* or *Angels*. Thus we find the *Prophet* was Transported from one place to another by an *Angel*; the *Body* of *Christ* by the *Devil*, to the Pinnacle of the Temple; the *Stone* remov'd from our Saviour's Sepulcher; and other like Examples, which prove *Angels* to have the Power of Moving Bodies.

There remains only one Difficulty to be explained; How *Angels*, that are *Immaterial*, can move *Bodies*, seeing they impress no *Quality* upon them, neither do communicate ought to the Thing moved, as *Bodies* do.

III.
How Angels move Bodies.

I Answer, That *Angels* move *Bodies* by their *Wills*, neither is there any thing else required to it. For tho' God (as shall be explained in our *General Physiology*) be the *Universal Principle* of all Motion whatsoever; yet this doth not exclude *Particular Causes*, that have a Power of Moving *Bodies*, according to that degree which God hath been pleas'd to impart with their *Wills*. And tho' it be difficult to comprehend how a *Spirit* doth act on a *Body*, and move it; yet are we not therefore to make a Doubt of it, only because we are ignorant how it is done.

IV.
Answer.

Indeed, if we duly weigh the Thing, we experience the same thing in our Selves: We find that our *Soul* moves our *Animal Spirits*; and directs them into the *Nerves* and *Muscles*, meely by the Inclination of the Will it hath to excite this or the other Motion in the *Body*: And we experience also, That the Motion of our *Spirits*, *Muscles*, and *Nerves*, is consequent upon this Propension of the Will; and yet all this while our *Soul* doth not understand, how and after what manner our *Soul*, being an *Immaterial thing*, moves a *Body*; and therefore neither is it any wonder, if we do not know the manner how *Angels* moves *Bodies*: In like manner neither do we understand, how from a certain Motion of the *Spirits* and *Blood*, the Affections of *Hunger* and *Thirst* are stirred up in us, tho' we plainly feel them of our selves. Wherefore we are certain that *Angels*, being *Spirits*, move *Bodies* by their *Will*, tho' the manner how, be hid from us, as being one of those things our Understandings cannot reach.

V.
We meet with the same Difficulty in our selves about Motion, which we find in Angels.

Neither do *Angels* seem to be destitute of the Power to produce and generate some *Bodies*. For since *Generation* is performed by *Motion*, and that nothing else is required to *Generation*, but a fit and suitable adaption of *Parts*, according to the Constitution of every thing; there is no sufficient Reason, why we should deny *Angels* such a Production. For in the *Generation* of a *Plant* or *Animal*, no new *Substance* is procreated, but only the *Particles*, whether Sensible or Insensible, acquire a new Connexion, and are otherwise disposed with relation to their *Magnitude*, *Motion*, *Rest*, *Figure*, and *Situation*; after the same manner as a *House* or *Watch*, which are framed without the production of any New Substance, by the fit joining of *Parts* before existing. And seeing *Angels* have the Power of moving, agitating, and reducing *Bodies* into order, neither can we deny them the Power of Generating them. Besides, *Angels* having great knowledge of *Natural Things*, by the study of their Virtues and Dispositions so many Thousand years, they cannot be ignorant at what times, in what places, with what Measure the *Qualities* of things are to be temper'd, and what will be the product of the Mixture of such and such *Particles*. Besides, we see *Men*, who are much inferiour to the *Angels*, produce divers things, which before were not extant, and which would never have been so without their Industry. Wherefore we must conclude, that *Angels* will be much more able to do so.

VI.
Angels may Generate Bodies.

This



To the Worshipfull
of the Citty of West-
the Clarke of their
Honourable Privy
This Plate is humbly



William Bridgeman
minster Esq. one of
Majestyes most
Councill &c.
Dedicated by Richard Blome



To the Worshipfull
Welham in the County
descended from the
the Holfords of



S^r William Holford of
of Leicester Knight.
Antient Family of
Holford in Cheshire.

This Plate is humbly

Dedicated by Richard Blome

VII.
Magicians,
by the help
of Devils,
produce
Animals.

This is prov'd, because *Magicians*, by the assistance of *Devils*, have produced some *Animals*, as *Frogs*, *Serpents*, *Dragons*, &c. So the *Scriptures* tell us that the *Magicians* of *Egypt* turn'd their *Rods* into *Serpents*, *Exod. Chap. 7*. Now that these were true *Serpents* appears hence, because the *Scripture* tells us, That the *Serpent* into which *Aaron's Rod* was turned, devoured the *Serpents* of the *Magicians*: For otherwise we must acknowledge, that *Moses* his *Miracles* were meer *Impossibilities*, and false *Appearances*.

VIII.
The Reason
why Man
cannot pro-
duce some
Animals,
proceeds
from the
unsuitabil-
ity of the
Matter.

If you say, That we cannot rightly argue from the *Natural Perfection* of *Angels*, that they have *Power* of producing *Animals*; since we see that *Men*, who by many degrees excel *Mice*, *Gnats*, &c. yet cannot produce or generate them.

I Answer, That this *Impotence* in *Man*, does not proceed from his *Inability*, but from the defect of *Matter*, proper for the procreating of such *Animals*. For every *Body* cannot be framed of every *Matter*, but of such only as *Nature* hath appointed for that purpose. For as a *Stone-Cutter* can do nothing without *Sand* and *Stone*, tho' he hath the *Power* of *Squaring* and *Polishing* them; so seeing that *Man* is destitute of fit *Matter* for the *Generating* of *Animals*, it is no wonder that he cannot produce them. Neither doth it oppose this, that divers *Plants*, *Fruits*, and *Flowers*, do arise from the *Seeds* that *Man* casts into the *Earth*: For if a *Man* had the *Seeds* of *Living Creatures*, and committed them to places suitable to their *Nature*, he would produce proportionate *Animals* from those *Seeds*. We may conclude therefore, that *Angels* understanding the *Virtues* of *Herbs*, *Juices*, *Metals*, *Animals*, and *Men*, may take whatsoever is required to the Composition of *Bodies*, or *Animals*, and disposing the same in a fit place, produce or procreate them.

IX.
Angels
cannot
Create.

But tho' *Angels* may produce *Material Substances*, yet can they not create them, nor *Spiritual things*. For it implies a Contradiction, that a *Creature* should produce any thing out of nothing; *Creation* being an Operation to which nothing concurs, save only the *Efficient Cause*; but if an *Angel* could create another, this Definition would not hold good; because the produced *Angel* would either totally depend on the Producing *Angel*, or would own *God* also for his *First Cause*. If the first; we must be forc'd to admit something Independent in the World, besides *God*, and so *God* would not be the *First Cause*. If the second; since this *Productive Power* in the *Angel* would be subordinate to *God*, the Effect would not be attributable to him, but to the *Primary Cause*.

X.
How we are
to under-
stand that
the Effi-
cient Cause
can produce
its own
like.

You will say, That a *Perfect Efficient* can produce its own like; as *Fire* can produce *Fire*, a *Lion* generate a *Lion*; and that therefore an *Angel* being more perfect than any *Material Thing*, can produce another *Angel*; not indeed by *Generation*, because an *Angel* is a *Simple Being*, not consisting of *Parts*, but by *Creation*.

XI.
Answer.

I Answer, That this Maxim of *ARISTOTLE* has no place in *Thinking things*, but only in *Material*, which are subject to *Corruption*, whose Property it is to preserve their *Species*, by the multiplication of *Individuals*: Whereas *Angels*, being exempt from *Corruption* and *Materiality*, have no need to preserve their *Species* by *Propaga-*

CHAP. VI.

Of the Number, Distinction, and Subordination of Angels.

It is certain from *Holy Writ*, that there are vast multitudes of *Angels*, which tho' they be sometimes express'd by a certain number, *Dan. 7. 10. Thousands of Thousands ministered unto him, and ten Thousand hundred Thousands assisted him. Revel. 5. 11. And the Number of them was, Thousands of Thousands*; yet they cannot be reduc'd to any determinate Number. For since *Great* or *Little* are only *Comparative Terms*, and no Number can be called the greatest, but in comparison with a lesser; the Multitudes of the *Angels* must be compared with some other Multitude, that by the Excess of either we may find out which is the greater.

Hence some are of Opinion, That the number of *Angels* is very great, if compar'd with the number of *Men*, that are, have been, or shall be; since it is not probable that *God* hath left such vast and magnificent Spaces without *Inhabitants*, except only the *Empyrean Heaven*: And because it seems probable to them, that the more *Perfect Beings* should exceed the less *Perfect* and *Ignoble*, in bulk or quantity, if they be *Extended*; and in Number, if *Spiritual*.

This Argument would indeed conclude something, in case the *Angels* were *Extended Beings*, and took up place; but being *Intellectual* and devoid of *Matter*, they cannot fill any Space. Nor is the Reason that supports this Argument of any strength: For if it were generally true, that things more *Perfect* must exceed the less *Perfect* in Number, I know no reason, but that upon the same account it might be concluded, that there must be more *Gods* than one; more *Suns* than *Planets*; more *Pearls* and *Precious Stones*, than *Common Stones*; the first of which is contrary to *Faith*, the second to *Reason*, and the third to *Experience*.

The *TALMUDISTS* reduce the *Angels* to certain Numbers, distributing them into several Companies or *Bodies*, and assigning to every one of them a set number (as it were) of *Inferiours*, as *Subjects* or *Soldiers*. For according to *R. F. Georgi the Venetian*, of the Order of *St. Francis*, the *Talmudists* distribute the Armies of the *Angels* into *Mazaloth*, *El*, *Legion*, *Ribaton*, *Chirton*, and *Giftera*. *Mazaloth* they say are Twelve, according to the XII Signs of the *Zodiack*. *El* are thirty Bands or *Regiments*, for every one of those Twelve; and accordingly there are 360 Bands of *Angels*. *Legion* multiplies this Number of 360 by 30; whence doth arise the Number 10800. And this Number they multiply again by *Thirty*; which makes up *Ribaton*, consisting of *Three Hundred and Twenty five Thousand*; which multiplied by *Thirty*, makes *Chirton*, consisting of *Nine Millions, Seven Hundred and twenty Thousand*. Which they multiply again by *Thirty*; the Product whereof is *Giftera*, consisting of *Two Hundred and Ninety one Million, and Six Hundred Thousand*. The Sum Total of them all being, *Three Hundred and One Million, Six Hundred Fifty five Thousand, One Hundred Seventy two*, as appears in the subjoyned Table.

I.
The Num-
ber of An-
gels is very
Great.

II.
According
to some,
the number
of Angels
far exceeds
the number
of Men.

III.
But with-
out any
cogent
Reason.

IV.
The Opinion
of the Tal-
mudists,
concerning
the Number
of Angels.

12	12 Mazaloth.
360	360 El.
360	10800 Legion.
30	324000 Ribaton.
10800	9720000 Chirton.
30	291600000 Giftera.
324000	301655172 Banns or
30	Regiments of Angels in all,
9720000	
30	
291600000.	

Whether the *Talmudists* have truly assign'd this number of the *Angels*, cannot be decided by any evident reason: Wherefore we may conclude with *St. Gregory* on the 26. of *Job*, *Humane Reason cannot assign the Number of the Superiour Spirits: because it doth not know the Multitudes of those Invisible Beings.* And a little after, *The Number of the Spirits or Citizens above can only be counted by God, but are Innumerable, as to Men.*

V.
All the An-
gels are not
of a dif-
ferent Spe-
cies from
each other,

As to the Difference of *Intelligences*, the *THO-MISTS* are of Opinion that all of them differ *Specifically*, and that Intellectual nature is their *Genus*. Their Reason is, because they make Matter the Principle of *Numerical Distinction*, and therefore suppose that all *Immaterial Things* must differ *Specifically*. But this is a mistake, forasmuch as *Numerical Distinction* doth not arise from matter, but from the *Essence* it self of every thing, whereby it is Distinguished from others. According to this Axiom, *Form gives the Being to a thing, or Essence* is that whereby a thing is principally known and differenc'd from others. *SCOTUS* therefore calls singular *Essence Haecceity*. For who will say that two *Modes* in the same *Body*, or two *Perceptions* in the *Soul*, differ specifically only because they are without Matter? Besides, two *Humane Souls* are immaterial, their notion involving nothing besides *Cogitation*; and yet no *Body* ever asserted their *Specific Distinction*: And why may not *Angels* as well differ only *Numerically* under the same *Species*, forasmuch as no Diversity is found in their *Nature*, which consists in *Cogitation*, nor any so great Distinction with Relation to their several *Offices*? For most of them have like *Offices*, and a common Operation. And therefore it is not to be question'd but that many of the *Angels* are of one *Species* and differ only *Numerically*.

VI.
Nothing
hinders but
that there
may be ma-
ny Species
of Angels.

Yet for all this, there may be many *Species*, for ought we know amongst the vast number of *Angels*, especially amongst those who are of a Different Order and *Hierarchy*. And this we shall be easily persuaded of by considering the several *Quires* of *Angels*, which seem to differ, as in their *Dignity* and *Offices*, so in their *Essence* also. For these *Functions* being proportioned to their several *Natures*, prove their different condition. Moreover, as the *Beauty* of this visible *World*, consists much in the Different *Species* of *Bodily Things*; so likewise we may with more reason conclude that the *Invisible World* is adorned and Beautified with the Diversity of *Spiritual Natures*. Tho' indeed this is a matter

we cannot absolutely determine, whether the *Angels* differ *Specifically*, or only *Numerically*, and therefore must say with *Damasceus*, *That he only knows this who hath Created them.*

There is without Question an Order and Subordination amongst the *Angels*, which some call a *HIERARCHY*: This is a Greek Word and signifies a *Sacred Rule or Principality*; or a company of *Sacred Princes*, who with some Subordination constitute one *Body*. This *Hierarchy* is commonly said to be twofold, *Ecclesiastical*, or *Heavenly*; the *Ecclesiastical* consists of *Prelats*, *Priests* and *Ministers* of the *Church*; but the *Heavenly Hierarchy*, is the whole Multitude of *Angels*, which is divided into three *Hierarchies*, viz. the superior, which by *FLUD* in his *Philosophy*, is called *EPIPHANIA*, to which belong the *Seraphims*, *Cherubims* and *Thrones*; the middle-most, or as he will have it, *EPIPHONOMIA*, which contains *Dominations*, *Virtues* and *Powers*; and the Lowest or *EPHIONIA*, which consists of *Principalities*, *Archangels* and *Angels*; to all which he assigns several *Offices*. The First of these, because of their most pure *Essence*, he places before *God*, as his *Assisting Ministers*: The second he makes to preside over the *Celestial Spheres*, and to have the Dispensing of their Influences to the inferior *World*: The Third he makes the Superintendents over *Sublunary things*, as being *Spiritual Creatures* diffus'd through *Bodies*, and Destinated to the Quickening and Moving of them, and are therefore call'd *Ministring Spirits*.

But because our forementioned *Doctor* writes very Enigmatically, so as to stand in need of an *Interpreter* rather than a *Reader*, I shall endeavour to give a short Explication of every one of these *Hierarchies*. The First, *Hierarchy* therefore is so called from the Relation they have to *God*, as being, as it were, his *Grandeess* and Honourable *Prime Ministers* and *Officers*, who being nearer to *God*, receive his Commands from his Mouth and impart them to *Inferiors*. They who are the highest in this *Hierarchy* are called *Seraphims*, that is, *Burning* or *Flaming*, from the fervour of *Divine Love* Burning in them; being most pure themselves, and greatly purifying others, and wholly aspiring to things that are on high. The Middle Order is that of *Cherubims*, so called from that Transcendent knowledg of all *Divine Mysteries*. The Lowest is that of *Thrones*, who as so many immovable Seats receive the *Rayes* of *Divine Glory*, and without any motion of their own, abandon themselves wholly to *God*.

Dominions, who are the first Order of the second *Hierarchy*, preside over those things that are to be done by *Inferiour Natures*, and by disposing and ordering of them, bear sway in the Government of *Humane Affairs*. *Virtues* execute with a masculine and unshaken Fortitude whatsoever they are charg'd with, as *Dionysius* expresseth it, *Hierarch. cap. 18.* Being always ready and prepared to perform the *Divine will*. Those that are call'd *Powers*, resist *Devils*, and restrain their power, from setting upon *Men*, and from Tempting them beyond their strength.

The Third *Hierarchy* also hath its particular Properties. *Principalities* are destinated to have the superintendence over *Princes* and *Prelats*: *Archangels* over *Kingdoms*, *People* and *Provinces*; and Lastly, *Angels* have the care of particular *Persons*,

VII.
The Im-
mense mul-
titude of
Angels is
distributed
into three
Hierar-
chies.

VIII.
The Three
Hierarchies
explained.

IX.
The Offices
of Angels
of the
Second
Hierarchy.

X.
The Pro-
perties of
the Third
Hierarchy.

sons, and are as it were *Ministers* and *Messengers* between God and Men. Whence it appears that there are Nine *Quires* or Orders of *Angels*; *Seraphim*, *Cherubim*, *Thrones*, *Dominions*, *Vertues*, *Powers*, *Principalities*, *Archangels* and *Angels*. The *Talmadists* also agree in the same Number, tho they call the several Orders by other names.

CHAP. VII.

Whether Angels be in a Place.

I. What Place is, and how many fold.

BEFORE we resolve this *Question* it will be necessary to Enquire what *Place* is, and how a thing is said to be somewhere. *Place* is commonly taken for that space in which things are; and it is twofold, either *Internal*, which is nothing but the space it self that every *Body* occupies, and which does not differ from its *Extension*, but by our manner of conceiving it, in that *Extension* in a space or *place* is consider'd in general, and as common to the *Air*, a *Stone*, a *Book*, &c. whereas in *Bodies*, that are said to be in *Space*, *Extension* is only consider'd Individually, and as Inseparable from them. Therefore as a *Body* consider'd in General consists of three *Dimensions*; so *place* is a *Space* Extended, according to the foresaid *Dimensions*; so that wheresoever there is a *Body* there must also of necessity be a *Space* or *Place*. *External* *Place* is the same with *Internal* *Place*, save only in that it denotes over and above the *Situation* and *Order* it keeps amongst other *Bodies*; and is properly nothing else but the surface of a *Body*, that surrounds another *Body*, and which with respect to the *Body* it surrounds, is no more than a *Mode*, since it cannot be understood without the Conception of a *Body*.

II. Angels are not in a Place.

These things being premis'd, I answer to the *Question*, that *Angels* and all *Spiritual Substances* have no place, neither *Internal* nor *External*. Because to be in a *Place* is the Affection of a *Body*, and therefore *Angels* being *Incorporeal*, and without any *Extension*, they cannot take up any place; and if they fill no *Space*, what *Situation* or *Order* can they have as to other *Bodies*? Wherefore *Spiritual things* can no more be said to be in a *place*, than they can be said to be of such a *Colour*, *Taste* or *Smell*, which denote *Bodily Modes*. So that to say that a *Thinking Substance* can become mensurate to a *Space*, is the same as if one should assert it to be material.

III. How we are to Understand that common saying, that Every thing that is, is somewhere.

You will say, if *Angels* be not contained in any *place*, then they must be nowhere, which is contrary to that *Axiom* of *Philosophy*, that *Whatsoever is, is somewhere*; and that *whatsoever is nowhere doth not exist at all*: But *Angels* do exist, therefore they must be in some place.

IV. Answer.

I answer, if by *Nowhere* you understand no *Space* Measurable by *Longitude*, *Latitude*, and *Profundity*, it may be admitted that *Intelligences* in this sense are nowhere, as being devoid of all *Dimensions*. But if by *nowhere* you mean, that *Immaterial Beings* do not exist at all, this cannot be admitted, forasmuch as in this sense they are *somewhere*, that is, they do exist. For it is not necessary that every thing that exists should be comprehended in some *Space*, this being only proper to *Extended Beings* or *Bodies*. Yea, even the whole *Universe*, containing the *Infinite Expansion*

of all things, is not comprehended in any *Place*, but is *everywhere*, that is, we can imagin nothing that doth enclose and surround it. And therefore the Category *Ubi* is only Attributable to the particular *Bodies* of which the *Universe* doth consist, not to the *Universe* it self.

Forasmuch therefore, as the *Angels* are destitute of all *Extension*, and do not concur as *Parts* to the Construction of the *Visible World*, as particular *Bodies* do, therefore neither can they be said to be somewhere, that is, to take up some *Place*. For we are to avoid the perverse Custom of *Common Philosophers*, who apprehend all things after a *Bodily* manner; by Attributing some kind of *Extension* unto them. And yet nothing appears more clearly to our *Mind*, than that *Cogitation*, which Constitutes the Nature of an *Intellectual Being*, is devoid of all *Extension*, and hath no commerce at all with *Matter*. Forasmuch therefore as *Space* in its Conception Involves *Extension*, it is evident that it cannot be Attributed to *Spirits*.

If you urge further, that *Angels* are *limited Beings*, which cannot be present to all places; and that which is not every where, is comprehended in some *Space*, and answers to the *Determinate* part of the *Divine Immensity*; and that therefore the *Angels* are in some certain *place*.

I answer, that this *Argument* is true in one Sense, and false in another. It is true as to the *First Part*, that *Angels* are *Finite Beings*, as to their *Essence* and *Operation*, seeing that they are *Creatures*, that depend on their *Creator* both as to their *Conservation* and *Production*. Yet can they not be said to be *finite* as to *Quantity*, because they are devoid of all *Extension*, and in that regard are neither *Finite* nor *Infinite*, and neither take up all *places*, nor are shut up in one certain *place*, forasmuch as to be *Extended*, and to be in a *place*, are one and the same thing.

It is true also, as to the *Second Part*, that the *Angels*, as all other *Creatures*, are contained in *Gods Immensity*; because his *Immensity* is nothing else, but his *Omnipotence*, by which he is present to all his *Creatures*, Producing and Preserving them, as has been explain'd at large in the foregoing part. So that this *Omnipresence* in *God* is nothing else but an *Extrinsic Denomination* springing from *Gods Operation*, which he works in all *Created Things*. But it is false that the *Angels* answer to any part of the *Divine Immensity*, if the *Divine Immensity* be conceived under the notion of *Infinite Extension*, including an *Infinite Quantity* of real or *Virtual Parts*: for seeing *God* is most *Simple* and free from all manner of *Extension*, he cannot be Co-extended to the many *Parts* of the *World*, nor fill any real or *Imaginary Spaces*.

Forasmuch therefore as *Angels* do take up no places, and cannot be said with respect to their *Substance* to be *Here*, *There*, or *Every Where*; it remains that their *presence* is only determinable by their *Operations*. And this seems to follow from the Nature of an *Intellectual Creature*. For seeing that the *Angels* are *Active Beings*, and that the life of *Active Existency* consists in *Operation*, we can only say that they are there, where they *Operate*, viz. in a *Body*, or about a *Body*. For since things are said to be *somewhere* according to their own *Proper Nature*, *Matter* being an *Unactive Lumpish thing*, is *Passively* Constituted in a *Place*

2

according

V. Angels being without Extension, cannot be said to be in a Place.

VI. How Angels can be said not to be somewhere, seeing they are Finite.

VII. Answer.

VIII. How the Angels are contained in the Divine Immensity.

IX. The Angels are said to be somewhere by their Operation only.

according to its *Length, Breadth, and Depth*: whereas a *Spirit* is said to be somewhat *Actively*, viz. by that force and Efficacy, whereby it governs and moves the *Body*, and carries it from one *Place* to another; and so is said to be present to that *Body* in which, and about which it immediately works.

X.
The Soul
by its Oper-
ation is
present to
the Body.

Accordingly in the *Fifth Part* of this Institution it will be declar'd that the *Soul* of *Man* is peculiarly present to the *Cdnarion* or *Glandula Pinealis*, Situate in the midst of the *Brain*; forasmuch as it Operates, and immediately exerts its *Powers* in the same. In like manner the *Divine Immensity* is deduced from his Operation about this *World*, so that before this Operation he could not be stiled *Immenſe*, no more than he could be called *Creator*, before ever he had Created any thing: Forasmuch as, according to what hath been said before, *Immenſity* denotes only a respect between *Created Things*, and *Gods Operation* about them. And upon this account it is that when we *pray* to *God*, we assign his proper place in *Heaven*, because he there exerts his most wonderful *Operations*, and more Efficaciously manifests his *Power*.

CHAP. VIII

How Speech is attributable to Angels?

I.
Speech is
twofold.

Notwithstanding that *Angels* are simple Beings, and do not consist of *Soul* and *Body*; yet most *Metaphysicians* Attribute *Speech* to them, whereby they are capable of conversing with one another. For that is not only call'd *Speech*, which is performed by the outward *Organs* of the *Body*, but also that inward speaking of the *Mind*, whereby it *thinks* or *perceives*; according to that Expression of the *XIV. Psalm*. *The Fool hath said in his Heart, &c.* and suitable to that way of speaking we so frequently use, when we say to others *What saith your Heart to this or that?* And of this manner of *Speech* *Divines* are to be understood, when they enquire whether *Angels* *Speak*, and make known their *Conceptions* to one another.

II.
'Tis not necessary that
Angels
should
speak to one
another.

This *Question* may be resolv'd from the *Third Chapter*; for seeing that *Angels* penetrate each others *Thoughts*, and Voluntary Determinations, they do not seem to need *Speech*, because this is only requisite for *Communication*, and mutual *Society*. For there are four things required to *Speech*. *First*, that it be free, according to the will of the *Speaker*. *Secondly*, That it be discovered only according to his intent and liking; so as to reveal secrets to those to whom it is directed, and conceal them from others tho' present. *Thirdly*, that the *Speaker* be able to excite him whom he is about to *speak* to, tho' he may be busied about other *thoughts*. *Fourthly*, That he that *bears* may know from whom the *Speech* proceeds.

III.
Angels
cannot
speak ac-
cording to
these Con-
ditions of
Speech.

But how shall the *Speech* of *Angels* be Free, when their *thoughts* are always open to others? and seeing it is not in their *Power* to conceal their *thoughts* from others? How will they be able to chuse their *Auditors*, so as not to open their *Secrets*, but to whom they please, since it is not in their *Power* to hide them, and that their *Perceptions* are as Natural as their *Substance*? Moreover how will they be able to excite their *Auditors* to the understanding of what they have to say, since they have nothing new to manifest to them? Lastly, how

shall the *Auditor* know him that *speaks* to him, and Distinguish him from others, if he be not call'd upon, and if from his knowledge nothing accrue to him? Wherefore we must conclude that *Angels* do not discourse together after the manner of *Men*; but that they so understand each others *Conceptions*, as that nothing is hid from them. Whence *Divines* tell us that the *Language* of *Angels* is their *Understanding*.

Neither is it any contradiction to this, what the *Scripture* mentions of the *Discourse* and *Speech* of *Angels*, as that of the 7th of the *Revelation*, where an *Angel* is said to call with a loud Voice to the four *Angels*; and in the 6th of *Isaiah* tis said that the *Seraphims* cried one to the other and said, &c. And the *Apostle* saith in the 13 Chapter of the first Epistle to the *Corinthians*, *If I speak with the Tongues of Men and Angels, &c.* because the *Speeches* here spoken of are *Visionary* and only seem'd to be utter'd by the *Angels*. For *Spirits* do not discourse together by an outward Voice formed in the *Air*; neither do they discover their *thoughts* as we do by any outward *Organs*. Therefore these *Speeches* were seemingly heard by the *Prophets*, for their *Illumination*, and that *Posterity* Reading their *Writings*, might be acquainted with those *Mysteries*, and be assur'd of them by their *Testimony*. As to that Expression of the *Apostle*, who Attributes *Tongues* to *Angels*, this must not be understood of those *Internal Speeches* which *Angels* use amongst themselves; but of those which *Angels* in former times used amongst *Men*, to manifest their *Conceptions* unto them, which tho' they were known and understood by *Believers*, yet served only to strike *Unbelievers* with *Wonder*, and *Astonishment*. And that this is the Genuine Sense of the *Apostle* in this place, appears from the *Words* immediately following, and have not *Charity, I am become as sounding Brass, or a tinkling Cymbal*; which is only applicable to outward *Speeches*, that is, to *Sounds* and *Voices* utter'd by *Bodyly Organs*, which we know cannot be fram'd by *Angels*.

IV.
Some Scrip-
tures ex-
plained
which at-
tribute
Speech to
Angels.

Neither indeed can it be shewed, how *Angels* *Speak* or *Discourse*, since it may be question'd whether the *signs* wherewith they express their *Thoughts* be *Spiritual* or *Corporeal*. And again, whether those *Signs* be Natural, or Voluntary. Whether all *Angels* make use of the same *Signs*, or every one of them have *Signs* peculiar to themselves. How it comes to pass, that when one *Angel* *speaks*, all the rest (without any difference) do not hear his *Speech*? By what Artifice their *Communication* may be hindred? Whether against their Will they perceive the *Speeches* of others; or whether their *Consent* be required to the perception of them? Whether *Angels* can reveal their *Thoughts* to some, and hide them from and impose them upon others? Which things, and many other such like, cannot be attributed to these *Heavenly Spirits*, and therefore prove their *Conversation* to be different from ours.

V.
The Man-
ner how the
Angels
speak is in-
explicable.

It remains therefore, if *Speech* be attributable to *Angels*, that the same only belongs to *Superiour Angels*, with respect to such as are *Inferiour*: For seeing that *Speech* is the manifestation of something unknown, if any New thing be discovered to them, it must proceed from the *Superiour Angels*. Wherefore *Divines* admit *Illumination*, which is a kind of *Speech*, to be amongst *Angels*, whereby they

VI.
Superior
Angels in-
form the
Inferiour
of things
unknown
to them.

they reveal unknown *Truths*, received from God to one another. And accordingly *DAMASCENUS* tells us in his *Second Book of Faith*, Chap. 3. *It is evident that all the superiour and higher Angels, do impart their Light and Knowledge to the Inferiour.* So that a more excellent Angel is as a Light to those that are under him, to illuminate them, and communicate new Knowledge to them.

VII.
Sometimes
this Order
is changed.

But tho' this manner of *Illumination* be the most ordinary and best agreeing with the *Angelical Orders*; yet it is not necessary that it should always be after the same way: For without doubt God may manifest a Mystery to some *Inferiour Angel*, which by him may afterwards be communicated to the *Superiour*; and accordingly some think it probable, that God communicated his purpose of being *Incarnate*, only to the *Archangel GABRIEL*, who was to carry the Message of it to the *Blessed Virgin*; notwithstanding that he belonged to the *Inferiour Hierarchy*. But according to the ordinary course, the *Superiour Angels* Speak, and the *Inferiour* Hear and Listen; the former, as *DIONYSIUS* tells us, being the *Guides and Teachers* of the latter.

CHAP. IX.

How Angels assume Bodies, and what Actions they exert in them.

I.
Apparitions
of Angels
have been
very frequent.

It cannot be question'd, but that *Angels* and *Devils* do really appear, and take up *Bodies* to make themselves Visible; this being a thing abundantly confirm'd by *Profane* and *Sacred History*. Thus the *Devil*, in the appearance of a *Serpent*, Tempted *Eve*, Gen. 3. *Three Angels* appeared to *Abraham*, Gen. 18. *Two Angels* came to *Sodom*, Gen. 19. The *Angel Gabriel* appeared to the *Blessed Virgin*, and brought her the Message of the *Divine Incarnation*. Neither can these *Apparitions* be ascribed to the Power of *Imagination*, or some *Melancholy Humour*, forasmuch as these *Bodies* can be felt, and manifest themselves by *Corporeal qualities*. Seeing therefore we cannot doubt of the Truth of these *Bodies*, it remains only to enquire, what kind of *Bodies* are fit for this use, and what *Actions* *Angels* exert in them.

II.
What kind
of Bodies
Angels do
assume.

As to the first of these Enquiries, it seems probable that the *Angels* chiefly assume *Aery Bodies*, which they form by their own *Power*, and adapt them to their *Intention*; so as that from the Different Disposition of the *Parts*, Variety of Colours do arise, and the *Figure* of a *Man* or *Beast* be represented to the *Beholder*. For these *Bodies* having real Extension, and being variously terminated, may according to the various *Reflexion* or *Refraction* of *Light* appear of another *Figure*, *Situation* and *Bulk*, than indeed they are. In this manner, the *Devil*, according to the Relation of *William of Paris* in his last part of the *Universe*, deluded a *Soldier*, by assuming the *Dead Carcase* of a *Beast*, who supposing himself to have enjoyed a Beautiful *Young Woman*, found himself, in the embraces of a loathsome rotten *Carion*: Which sort of *Delusions* are peculiar to *Devils*, who Understanding the Nature of *Bodies*, and being skill'd in *Perspectives*, can so order the matter, as to make things appear quite otherwise than they are.

Tho' this be the receiv'd Opinion amongst *Divines*, that *Angels* and *Devils* can assume true *Bodies* in order to their appearing to *Men*; yet I do not see but that they may visibly shew themselves without the taking up of *Bodies*. For seeing *Bodily things*, as *MAGNANUS* tells us in his *Philosophy of Nature* Cap. 33. have no other Power of Acting, than that of moving or resisting *Local Motion*, it will follow, that they appear to our *Senses* either by the *Motions* they impress upon them, or by their resisting of other *Motions*. Wherefore since we understand that a *Spirit* can exert all those *Motions* on our *Senses* which any *Bodily Substance* can, and likewise resist other *Motion* as well as any *Body* whatsoever; we may likewise conceive how a *Spirit* may be perceived by our *Senses* under the *Corporeal Form* of that *Body*, whose *Manner* and *Measure* of *Motion*, or *Resistance* of *Motion*, he shall purpose to imitate. Wherefore an *Angel* in Order to his appearing will not need to make himself a *Body* of such a *Colour*, *Figure* and other *Qualities*, as he intends to appear with; but it will be sufficient, if he only *Refract* and *Reflect* the *Light* in such a *Manner* and *Measure*, as that *Body* would, in whose shape he desires to appear.

III.
Angels can
appear
without
Bodies.

In like Manner when an *Angel* has a mind to make himself *heard*, it will be sufficient, if he only so beat and agitate the *Air*, as that *Sounding Body* would do whose *Sound* or *Voice* he designs to imitate. For by this means the *Agitated Air*, will communicate the *Motion* it hath receiv'd from the *Spirit* to the *Drum* of the *Ear*; and consequently will perceive a *Sound* like to that which the *Body* would have caused. And by this means an *Angel* or *Soul* may at pleasure appear to one *Person*, and hide himself from another, which would be impossible for them to do, after having assum'd an *Aerial Body*; because such a *Body* would indifferently appear to all.

IV.
How an
Angel can
make, a
sound to be
heard.

But forasmuch as both *Angels* and *Devils* do sometimes assume true *Bodies*, as hath been shewn from *Holy Scripture*, we are next to enquire how they are present to these *Bodies*, and what they *Work* in them.

V.
Supposing
Angels to
assume
Bodies,
what they
do in
them, and
work in
them.

Angels are not in *Bodies* after the same Manner as *Souls* are, so as that the *Motions* of the assumed *Body* and *Spirits* should follow the *Voluntary Determinations* of the *Angels*, and that the *Angels* also should be affected by the *Bodies* assumed. For herein doth the Union of *Spiritual* and *Bodily Things* consist, as shall be shewed in the ninth part of this *Institution*. Because it is one thing for a *Spirit* to be present to a *Material thing*, and another to be united to the same: Whenever a *Spirit* is joyned to a *thing*, he is also present with it; but not on the contrary; for a *Spirit* may be present with a *thing* and yet not be united to it. Now that conjunction which is between an *Angel* and his assumed *Body*, is not much unlike that, whereby the *Master of a Ship* is present to his *Vessel*, a *Coach-man* to his *Coach*, and a *Rider* to his *Horse*. For as the *Master of a Ship* may leave it, and return to it again at his pleasure; so the *Angels* may when they please quit their assumed *Bodies*, and remove into others; which they could not do, in case they were substantially united to them; as *Souls* are to the *Bodies* they animate. And as many *Pilots* may be in the same *Ship*, so more *Angels* or *Devils* than one may be in the same *Body*; as appears from the Gospel:

VI.
Angels are
not so intrin-
sically
joyn'd to the
Bodies they
assume, as
Souls are
to their
Bodies.

Gospel; but many Souls cannot be joyned to the same Body. The Soul is frequently against its Will united to a Body, and cannot at pleasure be separated from it, whereas an Angel is never unwillingly join'd with the Body it assumes. We conclude therefore that Angels are only accidentally, and as assisting Forms join'd to the Bodies they assume.

VII.
Angels
exert no Vi-
tal Actions
in Bodies.

From what hath been said, it is evident what Angels can perform in the Bodies they take up, and what Actions they exert in them; for it is manifest that they can produce no Vital Operations in them; for tho' they be willing to Eat or Drink, yet are they never troubled with Hunger or Thirst; and tho' they really Eat and Drink, yet have they no Sense of it; and the like may be said of other Corporeal pleasures, which no more affect the Minds of Angels, than that of Eating or Drinking. For all these suppose the union of a Spirit with a Body; and do not so much belong to the Mind as to the Body. For he who resolves for the Love of God to abstain from Eating, hath no will to Eat, because he is otherwise determin'd; and yet frequently feels the gnawing of his Stomach, and dryness of his Throat, and a natural desire to Eat and Drink. And in like Manner Venereal pleasure belongs to the Animal and sensitive life we have here, but not to the life we shall enjoy hereafter: for in the Resurrection, as the Scripture saith, Mankind shall be like the Angels, in Heaven and neither Marry, nor be given in Marriage. Matth. 22. 30.

VIII.
Devils can-
not ge-
nerate.

Whence it appears, that it is altogether irrational what some assert, that MERLIN was begot by a Spirit; that the People called HUNNI were begotten by Satyres on the Bodies of Gotbick Witches; or that CORCOTON a Demon in Hispaniola, was us'd to beget on the Bodies of Women, Births in the shape of Men with Horns on their Heads. These and such like Stories I take to be meer Fables: For seeing that Devils are immaterial, they can neither yield any Matter fit for that purpose of themselves, nor take it from any other Body, forasmuch as it is a part of the Living Body, and the remainder of the best concocted Aliment.

CHAP. X.

Whether there be any Order amongst the Devils; and what kind of Order that is.

I.
Since An-
gels have
different
Offices, there
must be
some order
amongst
them.

Forasmuch as the Devils are deputed to different Works, and according to TRITHEMIUS his Opinion, are sent abroad into divers parts of the World, they must of necessity observe some Order, and somewhat imitate the Government that is amongst the Angels of Light. For seeing they perform various Offices, and inhabit the Fire, Air, and Earth, as also the Waters and Bowels of the Earth, and that in perpetual Darkness; it does not appear how they could be kept to their several Tasks and Duties, if there were not some dependence between them, and if they did not derive their Power from one Head. Wherefore, LUCIFER in Holy Writ is called the Devil, because he is the Prince of all the Devils: And accordingly when the Pharisees told our Saviour that he cast out Devils by Beelzebub the Prince of Devils; he replies: If Satan be divided against himself how shall his Kingdom stand? By which Words Christ

himself supposeth that there is a Primacy, and consequently a Government amongst Devils.

The only difficulty here is to explain wherein the mutual subjection of the Devils is founded. Some fix it in the different Perfection of Devils, as supposing them to be endued with Power, according to the Proportion of their Dignity. But this seems to be said without sufficient ground; for there seems to be no Connexion between Natural Perfection, and Command or Moral Præeminence, except that the one should necessarily follow from the other; or that one should be the Rule of Manners; neither of which can have place in the Devils; for otherwise an Inferiour Angel would have as many Commanders and Rulers, as there are Angels more perfect than himself, which would be a most miserable State of Slavery, and Incomparably worse than any other.

II.
The Power
that An-
gels have,
is not pro-
portion'd to
their Per-
fection.

It seems more Rational to conclude that the Form of their Commonwealth, hath proceeded from themselves, and been established by their mutual consent. For tho' the Devils be exceeding Proud, and each of them hath Ambition enough to aspire to be Governour in chief; yet because they are full of hatred against God and the Envy they bear to Mankind, they suppose they can take no better way to Rob God of his Honour and to destroy the Souls of Men, than by mutually agreeing to submit themselves to a Government settled by Laws. Wherefore the Devils chose Lucifer the first Author of the Rebellion, to be their Prince, as Robbers us'd to do, who having join'd themselves together, choose one from amongst themselves to be their Captain.

III.
The Com-
monwealth
of Devils
is establish'd
by their
mutual con-
sent.

But what kind of Government the Devils have amongst themselves, is not easily Determinable, except we assent to them who divide the Devils into three Hierarchies and nine Quires, like the Angels. For so CORNELIUS AGRIPPA in his third Book of Occult Philosophy tells us, that there are Divines, who distribute the Devils into Nine Ranks, as standing in Opposition to the Nine Angelical Orders. Whose Opinion he follows and ranks them so himself.

IV.
The Devils
are divi-
ded into
Nine Or-
ders, like
the Angels.

The First Order of Devils according to Agrippa, are the PSEUDOTHEI, or False Gods, who Usurping the name of God, presume to be worshipt like God, and to have Sacrifices, and Adorations made to them; like that Devil, who said to Christ, All these things will I give thee, if thou wilt fall down and Worship me, shewing him all the Kingdoms of the Earth. And the Prince of these is he who said, I will ascend above the height of the Clouds, and will be like the most High; and who is therefore called Beelzebub, that is, the old God.

V.
The First
Order of
Devils.

The Second Order are the Lying Spirits, such as he was that entred the Prophets of Ahab, and was a Lying Spirit in their Mouths. And the Prince of these is the Serpant PYTHON, from whence Apollo is called Pythius, and that Woman Pythionissa, 1 Sam. 28. as also that Other in the Acts of the Apostles, Chap. 16. This sort of Devils make it their business to delude Men by Ambiguous or false Oracles, Divinations, and Predictions.

VI.
The Second
Order.

The Third Order of them are Vessels of Iniquity which are also called Vessels of Wrath. These are the Inventers of all Wicked Arts; such as was the

VII.
The Third
Order.

Devil



To William
Cosely Woodm
the County of
This Plate is humbly



- Benge of
- Wad herst in
- Sussex Gentleman
- Dedicated by Rich: Blome



To William Edgell
Parish of Hackney
Middlesex
This Plate is humbly



of Clapton in the
in the County of
Gentleman.
Dedicated by Rich: Blome

Devil *THEATUS* mention'd by *Plato*, who taught Men to Game and Play at Dice; for from these all Crimes and Wickedness do proceed, according to that of *Jacob*, Gen. 49. 5. where derelicting the cruel Massacre committed by his Sons *Simeon* and *Levi* upon the *Sichemites*, he saith, *Vessels of Iniquity are in their Habitation*: O my Soul come not thou into their Secrets, &c. The Psalmist calls them *The Vessels of Death*; *Isaiah*, *the Vessels of Fury*; *Jeremy* *the Vessels of Wrath*, and *Ezekiel* *the Vessels of Murder and Destruction*. Their Prince is *BELIAL*, which signifies without a Yoke or Disobedient, and is mentioned by *St. Paul* 11. Cor. 6. 15. where he saith, *What Concord hath Christ with Belial*?

Those of the Fourth Order are called *Avengers of Wickedness*, whose Prince is *ASMODEUS*, the Executioner of Justice.

The Devils next to these are *Juglers*, so called, because they imitate *Miracles*, and assist *Magicians* and *Witches*, seducing the People by their seeming *Miracles*, as the *Serpent* seduced *Eve*. An their Prince is *SATAN*, of whom it is written in the *Revelation*, that he deceives the whole world, working great *Miracles*, and causing Fire to come down from Heaven in the sight of Men, and deceiving the Inhabitants of the Earth, by the wonders he doth.

The Sixth Order are those that are called the Powers of the Air; these are very bule in Thunder and Lightning; they corrupt the Air, and cause the Plague; and of this Number were those, of whom the *Revelation* mentions, that it was given to them to hurt the Earth and the Sea. And their Prince is *MERIZIM*. This is the Noon-Devil, the Burning Spirit, and the Devil that rageth at Noon; whom *St. Paul* in his Epistle to the *Epheians* calls The Prince of the Powers of the Air, the Spirit that Works in the Children of Disobedience.

The Seventh Rank or Order is that of *Furies*, the fowers of mischief and Dissension, of Wars and Devastations; whose Prince in the *Revelation* is called *APOLLYON*, and in Hebrew *Abaddon*, that is, the Destroyer.

In the eighth Order are *Accusers*, whose Prince is called *ASTAROTH*, that is, a Spie; and in Greek *Diabolus*, that is to say a Slanderer; who in the *Revelation* is called the Accuser of the Brethren, who accuseth them before the Face of God, day and night.

The last Order of Devils are those that are called *Tempters*, or *Lyers* in wait, who do accompany Men continually to tempt them to Evil, and are therefore called *Bad Angels*. Their Prince is *MAMMON*, that is, Lust or Concupiscense.

And tho' this Ordination of the Devils be no where else to be found but in *Agrippa*, yet is it not therefore to be the less esteemed, seeing that it imitates the Orders of the Good Angels, and is derived and descends from *Lucifer* the Prince of the Apostate Spirits: So that as God hath his Angels, so *Lucifer* hath his Devils.

CHAP. XI.

Of the Care of Angels about Mankind, and the things here below.

It is manifest that God makes use of the Ministry of Angels, in the Ordering of things below; and there seems to be a twofold care in

them; the one General, whereby they are concerned for the whole World; the other particular, whereby they watch over particular Men. Wherefore *NAZIANZEN* in his 6th. Poem writes thus concerning them.

*Some with most Awful looks surround the Throne,
Ready and Girt to obey the Holy one:
Others support the World, and lend their Aid
To all the Several Creatures God hath made.
Their Care is diverse, as are Gods Commands,
These govern Men, and Those Cities and Lands.*

Accordingly the Ancients tell us of Universal Angels, every one of which did preside over a whole Nation, and were called the Angels or Genius of such or such a Nation: And of Particular Angels that are singly appointed to take care of this or the other particular Person, and are more particularly called *Genii*, because they superintend the Generation of particular Persons, and as soon as they are born do inseparably assist them. Such an Angel as this is called by *Epictetus* a Keeper, Particular Overseer, a Domestick Spie, a Proper Curator, an intimate Cognitor, a Continual Observer, an Individual Arbiter, an Inseparable Witness, a Reprover of Vice, and an Approver of Virtue. O ye Men (saith he in *Arrian*) take it for granted, that every one of us is committed to the care of a certain diligent and worthy Keeper: Whensoever therefore you shall have shut your Doors upon you, and shut out the Light from you, take heed you do not conceit your selves to be alone; for most certain it is you are not so; for God is with you; and so likewise is your good Angel.

What the Ancients called *Genii*, the same the Christians call Angels, and do own both their General and special Guardianship. For all Christians hold it for an undoubted Truth, that they have Angels deputed by God to be their Keepers and Companions, to inspect their Actions, to divert Mischief from them, and to take care for their Future Bliss and Happiness. For thus much may be deduced from the Offices of Angels, who, as the Apostle tells us, are *Ministring Spirits*, whose duty chiefly it is to put by the Devils Snares, to exercise Mens Minds to Virtue, to raise up such as are fallen, to suggest good advice, and to present their Prayers and Wishes to Almighty God. Indeed for this very cause they are called Angels, as being a kind of Messengers betwixt God and Men, whom they are to direct as School-masters and Pastors.

In this Angelical superintendency, the Providence of God most clearly appears, forasmuch as he governs and rules these things here below, by Superiour Powers, and Administers changeable things, by such as are Spiritual and unchangeable. For as by the Prudence and Forecast of a Good Emperour (saith *Chrysostom*) all Cities, Towns and Castles, are furnished with sufficient Garrisons against any Hostile Invasion, and all places so provided with Arms, that they may not stand in fear to be laid waste by a Barbarous Incurison: In like manner God, because the Devils with Barbarous and cruel minds are always hovering about us to overthrow our peace and happiness, appoints for our Safeguard the Hosts of his Angels, that by their presence, the stout boldness of the Devils may be repress'd, and the Grace of Peace much safed to us. For Angels are, as it were, the Protectors

II.
The Opinion of the Ancients concerning the Guardianship of Angels.

III.
The same confirm'd by Christians.

IV.
The Angelical care is deducible from the Providence of God.

VIII.
The Fourth Order.

IX.
The Fifth Order.

X.
The Sixth Order.

XI.
The Seventh Order.

XII.
The Eighth Order.

XIII.
The Ninth Order.

XIV.
This Ordination of the Devils is not to be respected.

I.
There is a twofold care of Angels.

of Men, specially deputed by God for their Safety : Not as if God were unable to save them ; but as a King, who orders his faithful Officers to crush the Delign of his barbarous Enemies , and to Chastize the Insolence of his Subjects.

V.
The same
confirmed
by Scrip-
ture.

Scripture also confirms the same to us: Do not despise one of these Little ones (saith our Saviour,) for their Angels continually behold the Face of my Father which is in Heaven. Wherefore it nearly concerns us always to continue in the Fear of God, as being certain that we have God's Angels about us, who observe all our Thoughts and Actions: And whenever we do that which is good, we cause great Joy to our Angels; whereas, if we do Wickedly, we drive them with grief away from us, and make way for the Devils to come to deceive and ensnare us.

VI.
The Effect
of the
Guardian-
ship of
Angels.

We see therefore that the Assistance of Angels is of great advantage to Men, by procuring them much Good, and by diverting many Evils both from their Souls and Bodies. They greatly assist our Minds, by enlightning our Understanding to perceive Truth, and by exciting our Will to the exercise of Vertue, and to embrace the Good that is offered to us: They also put by many Evils which threaten our Bodies, whether from Natural Causes, or from Free Agents, as from Men that are our Enemies, and from Devils; and prevent them from hurting those, whose Safety they take to heart. Sometimes also they send Sickness and Adversity, to correct Mens Vices, and thereby to reduce them to a sober and sound Mind. Yea, and sometimes may inflict Death also, and that in great Kindness; forasmuch as it may be very pro-

fitable and necessary for some to be taken out of the World, lest being overcome by the Vanities and Lusts of this World, they should run themselves into Perdition.

As there are Special Angels consigned to the Guardianship of Men, so there are others who have care of Cities and Countries committed to them, who, as so many Presidents, or Lords Lieutenants, do watch over them for their Good. And as a whole Nation doth in Dignity far exceed every particular Member of it; so do the Angels, that preside over a whole People, excel those who have the Care only of some particular Person. Now that Nations have their Guardian-Angels allotted them, is most evident from Scripture, Deut. 32. 8. When the Most High divided to the Nations their Inheritance, when he separated the Sons of Adam, he set the Bounds of the People according to the number of his Angels, as the Septuagint expresseth it. Wherefore the Ancient Fathers believed, that the Archangels had the Care committed to them of the Government of the Universal Church. Thus we read that MICHAEL fought with the Dragon, stood up for the defence of the People of Israel, is the Provost of the Church, and assists particular Angels. What is more clear in Scripture, than that GABRIEL was sent with a Message to the Blessed Virgin, about the Salvation of Mankind? and that RAPHAEL was sent to Succour Israel, and to exhort them to the Fear of God? All which are evident Testimonies of the Publick Ministry and Administration of Angels.

VII.
The Super-
intendence
of Angels,
extends it
self also to
Countries
and Cities.

The



G. Freeman Inv.

J. Kip Sculp.

To the Worshipfull Thomas Draxe of Sibsey in the County of Lincolne Esq.
This Plate is humbly Dedicated by Richard Blome



The Fourth Part
OF THE
INSTITUTION
OF
PHILOSOPHY.
VIZ.
GENERAL
Natural Philosophy.

CHAP. I.
Of the Essence and Certainty of Natural Philosophy.

I.
What Natural Philosophy considers.

HAVING considered the Nature of GOD, and enquired into his Attributes, as far as Human Weakness would permit, and afterwards examin'd the Essence of Angels and Devils, and discovered their Faculties and Operations; PHYSIOLOGY comes next to be considered by us, which contemplates Natural Things, and deduceth their Causes from their first Original. For the Order of Nature seems to require, that having laid down a Supreme and Universal Principle, we should next proceed to the examining of its Effects, that Affections belonging to them may be discovered to us.

II.
What Natural Philosophy is.

Natural Philosophy therefore, or Physiology, is the Science of Natural Bodies, and their various Affections. And therefore is called Natural Philosophy, because it enquires into the Essence of Material things, and treats of their Properties, Accidents, or Modes: And those are called Natural Things, or Bodies, which are endued with Nature, or that are compounded of Matter and Form, which are the inward Principles of their Activity, Passibility, and Cessation.

III.
The Word NATURE taken in a threefold Sense.

The Word NATURE is of various Signification: First, and more strictly, it is taken for the peculiar Disposition of Parts in some particular Body: For when we say, that it is the Nature of Fishes to live in the Water; it is the same as if we said, that the Disposition of their Organs is such, as makes the Element of Water most suitable to them. Secondly, It is taken more largely for the Universal Disposition of all Bodies: And in this

Sense it is nothing else, but the Divine Providence, forasmuch as it governs and directs all things by certain Rules and Laws, accommodated to the Natures of things. Wherefore God is said, to cloath the Lillies of the Field; to send Rain upon the Good and the Bad; and to give Food to all living Creatures; because, that by the Rules by him prescribed, all things conspire to the producing and maintaining such Effects as these. Thirdly, It is taken for the Essence of any thing, with the Attributes belonging to it: Thus we say, that it is the Nature of GOD to be Good, and the Nature of the Soul to Think.

IV.
Natural things do not differ from Artificial.

Neither do Natural things differ from those that are made by Art, save only in this, that in the former, how mean soever they be, there appears a far more excellent Artifice, and more exact contexture of Parts, than in the latter. Yet this is common to them both, that they are moved from an inward Principle, and perform their Functions by their own Virtue. For a Watch or Clock is no less moved of it self, by the Figure of its Wheels and Weights, than a Ball of Lead is, whilst it falls down through the Air, towards the Center of the Earth. For every Natural thing is moved by a Motion deriv'd from another, and doth always retain the same, till it be put by by a stronger.

V.
Physiology is a true Science.

Now that Physiology is a Species of Science, and is conversant about things that are True and Necessary, appears from the Demonstrations that are made of Natural things; the Certainty whereof depends on the Stability of the Things that are defined, and supposeth their determinate Essence. For Example, this way of Arguing, Every Extended thing is Divisible; A Body is Extended: Therefore a Body is Divisible, could never be esteem'd a Demonstration, if it were not most certain

certain that *Extension* enters the Nature of a *Body*, and that *Divisibility*, as a Property, ariseth from it. Now it is notorious, that all certain and necessary Knowledge, is *Science*; since no such can be had, but where the *Effects* are demonstrated by their true *Causes*: And that many such may be had in *Natural Philosophy*, is not to be question'd. For we know that *Matter* is moveable, because it is a *Substance* extended in *Length*, *Breadth*, and *Depth*. We know that every *Body* may be carried on from one place to another; because it implies a *Contradiction*, for one and the same *Body* to be in two places at one and the same time. And innumerable such like, which a *Natural Philosopher* considers as so many unshaken *Truths*, that cannot be gain-said by any Person in his Wits.

VI.
Whether
Natural
things be
discerned
by the
Senses.

If you say, That the *Certainty* which is required to *Science*, cannot be had in *Natural things*, seeing that *Bodies* and all their *Attributes* are only perceived by the *Senses*; which being liable to *Mistake*, may represent *False things* to the *Understanding*: Whence it is that not only *Children*, but also *Men* of *Age* labour under so many *Prejudices*, which they being unable to correct, persevere in their *Errors* to their *Lives end*.

VII.
Material
things are
not dis-
cerned by
the Senses.

I Answer, It is *False* that *Material things* are known by the *Senses*, as I have shewed by the Example of *Gold*, in the *Second Chapter* of the *First Part* of my *LOGICK*; forasmuch as it continues always the same, tho' it puts on divers *Forms*, and appears variously to the *Senses*. For if we mind well how far our *Senses* reach, and what that precisely is, which they represent to our *Minds*; we shall find, that they give us no such *Notions* of *Material things*, as we in our *Minds* have of them: And indeed, to speak properly, nothing is convey'd from things without us, by the *Organs* of *Sense*, to our *Minds*, save only some *Bodily motions*, by which the *Idea's* of *Objects* are offer'd to them. For what doth our *Sight* exhibit to us, besides outward *Images*, or our *Hearing*, besides *Voices* and *Words*? So that if we do apprehend any other thing besides those *Pictures* and *Voices*, that is, their *Signification*; we may be sure the same is offer'd to us, not by our *Senses*, but by those *Idea's* or *Notions* that proceed from our *Thinking Faculty*.

VIII.
But are
apprehend-
ed by the
Under-
standing
only.

Wherefore, *Bodily things* are not known by the *Senses*, but by the *Understanding* alone: So that to be sensible of a *Material Substance*, is nothing else, but to have an *Idea* of it, which is not the work of the outward *Senses*, but of *Cogitation*. Neither must this seem strange unto us, seeing that *Certainty* is required to perfect *Knowledge*, which since it cannot be had from the *Senses*, as being subject to *Error*, we must have recourse to the *Certainty* of the *Understanding* that may correct our *Errors*, and represent the true *Image* of the thing to us.

IX.
Whether
the Errors
occasioned
by our
Senses, can
be corrected
by our
Senses.

If you urge further, that there are many *Things* that cannot be corrected by our *Understanding*, except our *Senses* be first well-disposed, and that our *Mind* borrows its *Certainty* from them; as appears by a *Stick standing in Water*, which because of the *Refraction* seems to be broken or bent, when indeed it is *strait or whole*; because this *Error* is not to be corrected by the *Understanding*, but by the *Touch*: And the same may be said of the other *Senses*.

I answer, tho' by our *Touch* we know the *Stick* to be *straight*, yet is not that sufficient to correct the mistake of our *Sight*, but there is need of a *Reason* to persuade us, that in this case we are rather to give credit to the report of our *Touch*, than to that of our *Eye-sight*; which *Reason* cannot be ascribed to our *Sense*, but to our *Understanding* alone. It remains therefore that the knowledge of *Natural things* depends on our *Cogitation* and that they cannot be perceived by our *Senses* such as indeed they are.

X.
Answer.

You will object, that *Material Things*, of which *Natural Philosophy* treateth, do not continue in the same *State*, but are subject to various changes, quitting and assuming several *Forms*, which seems to be inconsistent with the *Notion* of *Science*, which is the knowledge of things *certain* and *Perpetual*. For what is more common than the *Rise* and *Destruction* of *Bodies*? For all things that consist of *Matter* and *Form* are subject to *Generation* and *Corruption*, and never continue long in the same state and condition.

XI.
An Objection
against
the certainty
of Bodily
things.

Nevertheless we must say, that *Natural Philosophy* is indeed a *Science*, because the *Nature* of a *Science* is not consider'd with respect to the things it treats of, but according to its *Axioms* of an undoubted *Eternal Truth*. For tho' the things which *Physiology* handles, be changeable; yet the *Judgments* we make of them are stable and firm; and consequently the *Truth* we have of them is *Eternal* and unchangeable. As for example, these are indubitable and constant *Truths*, that all that is *Bodily* is changeable; that every *Mixed Body* is dissoluble, tho' they be of mutable and changeable things. For as the knowledge we have of *Matter* is *Immaterial*; so we may have an *immutable Science* of changeable and corruptible things.

XII.
The Cer-
tainty of
Bodily
things estab-
lished.

Forasmuch as every *Science* hath a *Subject*, about which it is conversant, and to which, whatsoever is handled in the same may be attributed either as *Principles*, *Parts* or *Affections*; we say that the *Material Subjects* of *Physiology*, are *natural things*; and that *Magnitudes*, *Figures*, *Situation*, *Motion* and *Rest* are the *Formal Subject* of it; as under which, *Bodily things* are consider'd, and from whence they derive their force and *Virtue*, as shall be said in the 10th Chapter. Wherefore if a *Natural Philosopher* consider nothing in *Matter* besides these *Divisions*, *Figures* and *Motions*, and admit nothing for *Truth* concerning them, which is not evidently deducible from common *Notions*, whose *Truth* is unquestionable, it is altogether manifest, that no other *Principles* are to be lookt for in *Natural Philosophy*, than in *Geometry* or *abstract Mathematicks*: and consequently that we may have as well *Demonstrations* of *Natural Things*, as of *Mathematical*.

XIII.
The Object
of Physiolo-
gy.

But before I proceed any further, I must acquaint the *Reader*, that I undertake nothing here, but the explication of *Natural Things*; and that my only design is to explain them by their *Effects* and *Causes*, that so I may contain my self within the *Bounds* of the *Science* I treat of. Wherefore I openly profess, that I consider *Natural Things*, in their *Natural State*, and that my purpose is not in the least to treat of them, as they pass the *Bounds* of *Nature*, and are put in a *Supernatural condition*. For it would be great *Rashness* in me to set *Bounds* to the *Divine Omnipotence*, by pointing out how far

XIV.
Things are
consider'd
here in
their natu-
ral State.



To y^e Right Worshipfull
 Brasserton hall in y^e
 Yorke shire Knight, &
 Daughter & Coheyre of
 Yarrington in Oxford
 This Plate is humbly



S^r Samuel Gerard of
 North Rideing of
 to Elizabeth his Lady
 S^r Thomas Spencer of
 Shire Baronet

Dedicated by Richard Blome

far it can go. But rather as I acknowledge God to be the Author of the *World* and of all *things*, so likewise I own that *Infinite Things* may be produced by him, which the mind of Man cannot reach in the least.

XV.
Natural
Philosophy
is either
General or
Special.

Natural Things are considered two manner of ways in *Physiology*, viz. either *Generally* or *Specially*; and accordingly *Natural Philosophy* is Distinguish'd into that which is *General*, and that which is *Special* or *Particular*. *General Physiology* is, that which considers a *Body* or *Matter* in *General*, that is, its *Nature*, *Principles*, *General Affections* and *Differences*. *Special* or *Particular Physiology* is that, which considers *Matter* as distinguish'd into *Species*; and doth more particularly explain the *Properties*, *Differences* and *Changes* of those several *Species*. Wherefore we are to begin with the most simple *Principles* of *Natural Things*, and from them proceed to the *Bodies* themselves, that are made up of them.

CHAP. II.

The Existence of Material Things Proved.

I.
We may
question the
Existence of
Bodily
things.

FORasmuch as it is lawful to doubt of every thing, whether or no it do Exist, as long as its nature is not clearly known to us; we may also question whether *Material Substances* be, beside our *Cogitation*, and if they be, by what *Argument* this may be proved: As to which thing every one will be able with great ease to satisfy himself in this matter, only by giving heed to the Conception we have of *Bodily Things*.

II.
The Notion
of a Mate-
rial thing
frequently
occurs to
us.

No *Philosopher* ever deny'd that we have the Notion of *Material Things*; yea, if we thoroughly examine their *Nature*, we shall find many *Properties* in them, which would not agree to them, if they had not some *Nature*. For we can Demonstrate of an *Extended Being*, that it is *Moveable*, *Divisible*, *Impenetrable*, &c. For since to be extended is nothing else but to have distinct *Parts*, it cannot happen by the *Power* of *Nature*, that the parts of *Matter* should take up the same place.

III.
God can do
whatsoever
can be
clearly
known, or
apprehend-
ed by us.

Moreover, we know God to be *Omnipotent*, and that he can do whatsoever can be clearly and distinctly known by us. Yea, if we will reason aright, we must say, that nothing is impossible, but because it is inconsistent with our clear and distinct perception: But we do clearly and distinctly know *Matter* to be something extended in *Length*, *Breadth* and *Depth*: Therefore *Matter* must at least be producible by God.

IV.
The Actual
Existence of
Bodily
things
proved.

Nor will it be difficult to prove that this *Material Substance* doth exist actually. For tho' our *Senses* be apt to deceive us; yet we cannot doubt of all the things they represent to us. Because we daily experience and find in our selves many *Ideas* or *Species* of *Natural things*, which must proceed from some things or other without us, that are the *Causes* of such *Ideas*. For it doth not depend on our *Wills*, that we perceive by our *Senses* one *Substance* more than another; but that difference proceeds from the *Objects*, which produce such a Sensation in us. For oftentimes these *Species* occur to us without our heeding it, and before that we think of them by any reflex *Cogitation*. Wherefore we must conclude that these *Ideas* proceed from things, which consequently must exist in *Nature*.

Lastly, there is no *Man* who doth not perceive himself to be endued with an *Imaginative Faculty*, in that he doth almost every moment conceive so various and different *things*; now the *Imaginative Faculty* considers *Bodies* as present, and is altogether conversant about *Bodies*; wherefore it is necessary in order to its perfection that *Material Things* should exist.

If you object, that nothing of certainty can be gather'd from the *Senses*, forasmuch as they do frequently deceive us. For we find by experience that things are represented by them otherwise than they are, as when a *Square Steeple* appears round to us at a distance; or when a great *Brass Ball* at the top of a high *Steeple*, shews like a little *Apple* to our Sight.

I answer, that these *Errors* do not destroy the Truth of *Material Things*, tho' our *Senses* deceive us in their representing of them. For it may happen that that which I see with my *Eyes*, is quite another thing than I imagin it to be; yet for all that it cannot be, but that which does appear to me must be something *Material*, which is sufficient to prove the Existence of *Matter*; because the variety of *Figures* does not take away the *Subject*, but rather doth manifest it, and forceth us to confess, that those *things* that appear to us under divers *Figures* are something that is *Material* or *Corporeal*.

Neither do those things that are within us, less evidence this Truth than those that are without us: For if we give heed to the *Ideas* of *things* in our *Mind*, we shall find that besides the notions of *Intimate Consciousness*, *Perception*, *Judgment*, and *Affections*, we meet with others that consist of *Extended Parts*, diversified by *Length*, *Breadth* and *Depth*. Moreover, besides these, we experience many *Motions* in our selves, as *Hunger*, *Thirst*, *Pain*, which do not belong to our *Soul*, forasmuch as it is a *Thinking Being*; for the *Soul* of *Man* being *Immaterial* is incapable of any of these, and only perceives them as she is united to a *Material Substance*. For *Pain* doth not touch our *Mind*, save only so far as it is join'd to the *Body*; neither can it be vexed with *Hunger* or *Thirst*, save only so far as it is link'd to the *Stomach* and *Throat*, the one whereof is pinch'd with a *Vellication*, and the other with *Drought*. So that it cannot be doubted but that there are many *Ideas* of *Natural Things* in us which are not fram'd by our selves, but come to us from abroad, and present themselves to our *Imagination*.

For as the *Philosopher* discourseth in the last Part of his *Principles*, Sect. 1. We may enquire concerning the thing which is represented to us, whether it be God, or something distinct from him: But because we feel, or rather by *Motions* impress'd upon our *Senses*, do clearly and distinctly perceive a certain *matter* extended in *Length*, *Breadth* and *Depth*, whose various parts have diverse *Figures*, and are tost with several *Motions*, and are the cause of Diverse Sensations in us, as of *Colours*, *Smells*, *Pains*, &c. If God did immediately by himself represent the *Idea* of *Matter* to our *Mind*; or if he should cause the *Idea* thereof to be represented to us, by any thing wherein there was nothing of *Extension*, *Figure* or *Motion*, this would be to impose upon us. For we clearly understand *Extended Matter*, as a thing altogether distinct both from God and from our selves, that is, our *Minds*; and

V.
Tho' the
Senses de-
ceive us in
the manner
of their re-
presenting
things to
us; yet
not with
respect to
the sub-
stance of
things.
VI.
Answer.

VII.
The Moti-
ons we find
in our
selves prove
us to be
Corporeal.

VIII.
If there
were no ma-
terial
things
without us,
God might
be thought
to impose
upon us.

we clearly seem to perceive that the said *Idea* proceeds from things plac'd without us: Now it is utterly repugnant to the Nature of God to impose upon us. And therefore we must peremptorily conclude that there is really *Existing* such a thing as is extended in *Length*, *Breadth* and *Depth*, and hath all those *Properties*, which we do clearly perceive do agree to such a Being. And this is that thing which we call *Body* or *Matter*.

IX.
The Order
of things
to be hand-
led hereaf-
ter.

But forasmuch as every thing is best known by its *Essence*, *Properties* and *Affections* or *Accidences*, to the end we may have a more perfect knowledge of *Matter*, whose *Existence* we have just now demonstrated, it must be our business to prove, wherein its *Nature* doth consist, what are its *Properties* and what *Accidences* it is capable of. Accordingly we will first enquire what it is that doth constitute *Matter*, and next what those things are that do inseparably accompany it, and lastly the *Accidences* that happen to it.

CHAP. III.

Of the Nature and Constitution of Matter.

I.
What Mat-
ter is, and
how it dif-
fers from a
Body.

Matter is a *Body*, inasmuch as it is a *Body* or a *Substance* extended in *Length*, *Breadth* and *Depth*: Wherefore a *Material* and a *Bodily* thing are *Synonymous Terms*, and do not differ, save by our *Mode* of considering them. That which consider'd absolutely is call'd a *Body*; the same with regard to that which is made of it, is call'd *Matter*: As for example, this extended *Mass*, consider'd as something undivided, and indistinguish'd, is a *Body*; but if refer'd to those distinct *Bodies* that are made out of it, it is call'd their *Matter*.

II.
This Mat-
ter doth not
differ from
Aristotles
first Mat-
ter.

This is that *First Matter* about which there are so many Squabblings in the *Peripatetick School*; and is nothing else, but an inadequate Conception of a *Body*, as it may be conceiv'd by us without any *Figure*, *Hardness*, *Softness*, *Colour*, or any other Modifications, and only as Extended, and consisting of three *Dimensions*. For the further Explication of this *Notion*, and that the agreement of the *Cartesians* and *Peripateticks* in this matter may appear, I shall add these following *Propositions*.

III.
How Mat-
ter is said
to be with-
out Form.

The *First Proposition*: The *First matter* is without form: For in this, the *Notion* of *Extension* is abstracted from all Modifications, that belong to the *Essence* of a *Body*.

IV.
How it is
the same in
all Bodies.

The *Second*: The *Matter* of all things is the same; for all *Bodies* agree in this first or Primary *Attribute* of a *Body*, viz. *Extension*, neither is there any Distinction between them with relation to the *Matter*.

V.
How Mat-
ter is capa-
ble of all
Forms.

The *Third*: Every thing may be made of every thing; or, according to the *Peripateticks*, *Matter* is capable of all *Forms*: For since all *Bodies* agree in *Extension*, all their difference must be from their various Modifications; if therefore there be an *Efficient Cause* sufficient to alter these *Modes*, it may make every thing of Every thing. On this *Proposition* are grounded all those varieties which are observed in *Bodies*.

VI.
How it is
ingenerable
and incor-
ruptible.

The *Fourth*: A *Body* as such, or the *First Matter*, is *Ingenerable* and *Incorruptible*: that is to say, there is no new *Substance* created; neither is the

least part of *Matter* annihilated; for only the *Modes* are changed, in all Alterations.

Physical Matter therefore, or a *Natural Body*, is a *Substance* Extended in *Length*, *Breadth* and *Depth*; neither can any thing else be represented to the *Imagination* by the name of *Matter*: For *Extension*, as hath been said, is that Primary, *Intimate*, and *Radical Attribute*, which is conceiv'd or apprehended in every *Body*, and which in all alterations continues the same, nor can it be destroyed, but by Annihilation of the *Body*. So that we must stand to it as an undoubted Truth, that *Extension* is identified, that is, is one and the same thing with *Matter*, so that how much soever is taken from *Quantity*, so much is taken away from the *Body*; and on the other hand, whatsoever is taken from *Body*, the same is taken from the *Quantity* of it.

Most men I know are of *Opinion*, that herein we differ from *Aristotle*, who in his *Metaphysics* tells us, that *Matter* of it self is neither *Quid* (something) nor *Quantum* (of any Bulk or *Quantity*) nor any other thing of all those, whereby a *Being* is determin'd. From which words they argue that *Aristotle* supposed *Matter* to be devoid of all *Extension*, yea that it did not exist in the nature of things.

To which I answer, that *Aristotle* indeed makes a distinction between *Extension* and *Quantity*, which we also freely admit, because *Matter* may be conceived without *Quantity*. For he that Measures a piece of *Land*, immediately conceives the *Extension* of it, but doth not know the *Quantity* of it, till after he hath measur'd it. Indeed *Quantity* is nothing else but a certain mode of *Extension*, or some Measure of it, by which we answer him, who demands what the *Quantity* or *Bigness* of a *Body* is. And so *Quantity* is an *Attribute* modally distinct from *Extension*. And in this *Sense* it is not repugnant to say, that *Matter* is an extended *Substance*, and yet that it is nothing of all those things which *Aristotle* in the foresaid place removes from it; forasmuch as they cannot be understood but of *Matter* determin'd by some particular Form. Thus we cannot say that *Matter* Universally taken, and as consider'd at first view, is either *Hot* or *Cold*, that it is of such a determinate Measure, or that it is some particular thing, as *Wood*, *Marble*, *Gold*, &c. much after the same manner as when we consider a living *Sensitive Creature* in General, we cannot say that it is a *Horse* more than a *Lion* or any other particular *Species*.

Neither do those argue at any better rate, who distinguish *Extension* from *Matter*, and consider it only as a *Mode* of it: As for example, whilst they mind the *Extension* of a *Table*, they will have the *Extension* to be the *Mode*, and the *Table*, the *Substance* whose *Mode* it is: For these talk as absurdly, as if one hearing another discoursing of the *City of Rome*, should imagine these to be two different things, whereof the one should be the *Mode* and the other the *Substance*; or as if one should go about to distinguish *Humanity* from *Man*. For as *Humanity*, or the Nature of *Man*, doth not differ from *Man* generally consider'd, but only as an Abstract and Concrete, so neither doth *Extension* differ from a *Body* in a general acceptance.

Those therefore who deny that *Extension* constitutes the Nature or *Essence* of *Matter*, will never be able distinctly to explain what they mean by the

VII.
What we
are to un-
derstand by
the word
Matter.

VIII.
Aristotle
doth not op-
pose this
Doctrine in
his Meta-
physics.

IX.
Extension is
not the
Mode of a
Body.

X.
Why the
Natural
Philosophy
of the
Schools is so
barren.

Word

Word *Matter*, nor wherein its *Essence* doth consist: Yea, they lay that down for a *Principle*, from which it is impossible for them to deduce any Consequence, which may illustrate the *Mind* of Man, or be of use towards the discovery of any *Truth*; and therefore they must not wonder to find their *Physiology* so barren as it is, and that they have not been able hitherto to explain the least product of *Nature* by means of it.

XI. *Whether there be no more Matter in a Vessel fill'd with Gold, than in one fill'd with Air.*
But they who estimate the *Properties* of *Matter* by their *Senses*, and by them measure the *Essences* of things, argue thus against this Opinion. If a *Bodily Substance* were something indistinct from Extension, it would follow, that wherever there was found some *Proportion* of *Matter*, there would also be the same of *Quantity*: But this is found to be false in two Vessels of the same bigness, forasmuch as more *Matter* is found to be in that which is fill'd with *Gold*, than in the other which is only fill'd with *Air* or *Water*. Therefore *Quantity* is not always proportionate to the *Body*, and consequently differs from it.

XII. *Answer.*
I answer, that there is no more *Matter* in the *Vessel* that is fill'd with *Gold*, than in the other that contains *Water* or *Air*, tho' indeed there be more *Hardness* and *Weight* in the one than the other: For the *Essence* of *Matter* doth not consist in *Hardness* or *Weight*, or any other *Qualities*; for *Fire* that is subtil, and melted *Wax* that hath lost its *hardness*, is never a whit less a *Body*, than the heaviest *Metal*; and therefore *Matter* precisely consists in this, that it is extended in *Length, Breadth and Depth*, which is found to be equal in both Vessels.

XIII. *The Nature of a Body doth not consist in Hardness.*
Conclude we therefore, that the *Nature* of *Material* things doth not consist in *Weight, Hardness, Colour*, or the like, but in this only that they are Extended Beings. For as to *Hardness* we can apprehend nothing else of it by our *Sense*, than that the *Parts* of hard *Bodies* resist the Motion of our *Hands*, when they run against them; for if as oft as our *Hands* are mov'd towards any place, all the *Bodies* that are there should give way, and remove thence with the same *swiftness*, as our *Hands* advance, we should never feel any *Hardness*. Neither can it be conceived, that the *Bodies* which thus remove or give way, should therefore lose the *Nature* of *Bodies*: wherefore the *Essence* of *Material Things* doth not consist in *Hardness*.

XIV. *Nor in Figure, Weight, Colour, &c.*
And in like manner it may be made out, that *Weight, Colour*, and other such *Qualities*, which by the *Senses* are perceiv'd in *Matter*, may be taken away from it self, remaining whole as before: For suppose the *Hardness* of *Ice* melted into *Water*, to be vanished; its *Figure* also to be quite changed; suppose also that *Water* to be rarified into *Vapors*, and having quit its Bulk and *Heaviness* to disappear from our *Eyes*, by its extreme *Tenuity* and *Thinness*; yet it is evident that the *Bodily Quantity* or *Extension*, which is the *Seat* and *Subject* of all these mutations, does remain entire and untoucht, and altogether inseparable from the *Ice*, the *Water* and *Vapors*.

XV. *An Object on that Matter ought to be Defined by some Relation to the Senses.*
It may be you will say, that tho' a *Body* be not bound to one *Figure*, and may be deprived of a *Cubical, Triangular or Spherical Figure*, yet must it still have some *Figure* or other. In like manner tho' a *Body* be not necessarily either *Soft* or *Hard, Hot* or *Cold*, yet it is necessary that a *Body* should be sensible, or as *Lucretius* expresseth it, *Tangible*.

Besides a *Body*, as we see,
Nothing can Touch, or Touched be.

To which I answer, *First*, that *Sensibility* is only one of the *Properties* of a *Body*, and not the whole nature of it; since a *Body* may really exist, tho' there should be no Men to whose *Senses* it might offer it self to be perceived; as we know that *Matter* was created before there were any *Senses* made. Wherefore there seems to be no absolute *Necessity* that every *Body* should be sensible. On the contrary, we find that there is no *Body*, which may not become insensible, by being divided into so minute parts, as not to be able to move our *Nerves*, especially if those parts be also swiftly moved.

I answer *Secondly*, that a *Power* to affect the *Senses*, presupposeth something that is extended, and is no more than a *Respect*, and *Extrinsic Denomination*, which must be grounded in some Internal or absolute *Attribute*.

Extension therefore is that alone which constitutes the *Nature* of a *Body*, as agreeing to all, only, and always to them, so that nothing can be perceived in a *Body* before it. For it agrees to every *Body*, to *Earthly* as well as to *Heavenly*, to the *Sun, Fire, Air*, as well as to *Wood, Stone, &c.* It belongs only to a *Body*, because no *Intellectual Substance* is Extended and Divisible. And it agrees always to a *Body*; because tho' all other *Attributes* be taken from it, and be changed, yet the *Extension* continues as long as the *Body* doth. Besides, nothing can be conceived in *Matter* before *Extension*; for tho' *Matter* be Divisible into *Parts*, yet that is not the first affection we perceive therein; for therefore only a thing is Divisible because it is extended.

Some are of opinion that *Quantity* may be encreased, without any encrease of the *Matter*: Thus in *Rarefaction* the *Quantity* seems to be augmented, tho' the *Substance* continue the same it was; and this they endeavour to prove by a *Pot of Water* on the *Fire* that boils over; at which time they suppose the *Water* to take up more place than it did before; now it cannot take up a larger place, without a greater degree of *Extension*.

I answer, that *Rarefaction* is not performed by an addition of *Quantity*, but by the entrance of other little *Bodies* from abroad; so that those *Bodies* are said to be rarefied, whose *Pores* being opened are filled with the *Air*, or some other *Subtil Matter* entering into them; and they become close or compact again, when by the expulsion of those *Adventitious Particles*, those *Spaces* are narrowed again, and the parts come closer together. For certain it is, that nothing can be encreased in *Quantity*, but that at the same time its *Extension* must be encreased also. Of which I shall treat more at large when I shall have occasion to speak of *Rarefaction*.

But you will object, that *Space* is conceiv'd to be something extended in *Length, Breadth and Depth*: Yet *Space* is not a *Body*; therefore the *Essence* of a *Body* doth not consist in *Extension*. The *Minor* is proved, for that if *Space* were a *Body*, then one *Body* would be in another.

I answer, It is false to say that *Space* is not a *Body*; because the same *Extension* which constitutes the nature of a *Body*, doth also constitute that

XVI.
The First Answer.

XVII.
The Second Answer.

XVIII.
Extension only belongs to the Essence of a Body.

XIX.
That Quantity seems to be encreased in Rarefaction.

XX.
Rarefaction is performed, by the introduction of another Matter.

XXI.
An Objection from the Nature of Space.

XXII.
Answer.

that of *Space*. And therefore to say that a *Body* takes up such a *Space*, is no more than to say, that it is so great a part of the *World*; because *Bodies* bring their *Spaces* along with them, and when they remove, carry them away with them. And when *Bodies* are said to leave their *Spaces*, it is the same as to say that they quit the *Magnitude*, *Figure* and *Situation* they had amongst other *Bodies*. Wherefore the *Extension* of *Space* doth not differ really, from the *Extension* of a *Body*, and therefore we must conclude every *Space* to be corporeal.

XXIII.
Tho' God be
immense or
infinite, yet
he hath no
quantity.

And whereas some say that *God* occupies or takes up all places of the *World*, as being *Infinite*, *Immense* and *Omnipresent*, &c. which cannot be conceived without some *Extension*; this is an objection of no moment. For tho' *God* be *Omnipresent*, yet this doth not prove him to be extended; because by an *Extended Being* all *Men* understand something that is *Imaginable*, of a certain *Figure* and *Magnitude*; whose parts are separate from each other, so that one of them cannot be in the place of the other; which cannot agree to *God*, or any *Spiritual Substance*, as being imperceptible to the *Imagination*, and apprehended by the *Intellect* only. When we say that *God* is extended through all the *World*, this is not to be understood of the *Extension* of *Substance*, but of the *Extension* of *Power*, so that the meaning only is, that *God* can exercise his *Power*, sometimes on a greater, and other times on a less part of *Matter*. For if there were no *Bodies*, we could not conceive a *Space*, to which *God* should be co-extended.

XXIV.
A Natural
Body is the
same with
a Mathe-
matical
Body.

Wherefore with our *Philosopher* I profess my self to own no other *Matter* of *Bodily things*, than that which is altogether *Divisible*, *Figurable* and *Moveable*, which *Geometricians* call *Quantity*, and which they make the object of their *Demonstrations*; and that I consider nothing in it, besides those *Divisions*, *Figures* and *Motions* which are the properties of it. And tho' such a *Body* as I have here described, be by others called *Mathematical*, yet I take it here in this *General Physiology* for a true and *Real Body*. Indeed *Natural Philosophy* is one of the parts of the *Mathematicks*, and has the same relation thereto, as *Metaphysics* have to the other *Disciplines*; the only Difference between them is, that the *Mathematicks* consider *Magnitudes* and *Figures* abstractedly, without being solicitous whether they be such indeed, or only can or may be so. But *Physiology* considers the same as inherent in *Matter*, and as she finds them in the several *Bodies* that are in the *Universe*. Now this *Abstraction* doth not at all hinder, but that *Physical* or *Natural Matter* may be the same with the *Geometrical*, because the *Species* is not really distinct from its *Genus*.

CHAP. IV.

Of the Proprieties of Extended Substance,
viz. Mensurability, Divisibility and Im-
penetrability.

I.
Mensurabi-
lity, Divi-
sibility and
Impenetra-
bility are

Here are three *Properties* which accompany an *Extended Substance* or *Quantity*, viz. *Mensurability*, *Divisibility* and *Impenetrability*. *Mensurability* is an aptitude in a *Body*, whereby

it may be apply'd or conform'd to a certain measure. *Divisibility* is that disposition of a *Body* whereby it is conceiv'd to have *Parts* into which it may actually, or by thought, be divided. Lastly, *Impenetrability* is the distinction of one *Extended Being* from another, by which the *Extension* of one thing is different from that of another; so that two things *Extended* cannot be in the same place, but must of Necessity exclude each other.

That a *Bodily Substance* is *Mensurable* and *Divisible*, may be easily gathered from what goes before; for since it hath a threefold Dimension, *Length*, *Breadth* and *Depth*, it must also admit a threefold *Measure*, by which its *Magnitude* may be determin'd. Its *Divisibility* also may be gather'd with the same evidence from its *Extension*, forasmuch as it hath *Parts* placed besides one another, so that we may easily conceive them to be separable, in which the very *Essence* of *Division* consists. But because many, who follow *DEMOCRITUS*, are of opinion, that there may be *Indivisible Bodies* out of which all other things are made, it will be worth our enquiry, whether the parts that constitute *Matter*, be *Indivisible*, or such as admit of further *Division*.

To which I answer, that *Matter* is not compounded of *Indivisibles*, that is, of parts that cannot be divided into others. This is the opinion of most *Philosophers*, and the reason is this, because the *Essence* of *Matter* is to have parts that are extended; and whatsoever is extended, is *Divisible*. For it cannot be conceived that a thing should be *Extended*, and yet not be *Divisible*; because *Extension* is nothing else, but an answerableness to divers points of *Place*, and such a disposition wherein one part is distant from another, not by actual separation, but by an aptitude to be separated, which is sufficient to make one thing not to be another.

Moreover, *Beings* are not to be multiplied without necessity; now there is none that forceth us to have recourse to *Indivisibles*: For *Points* are not the *Parts* of a *Line*, but smaller *Lines*; neither are the *Parts* of a *Surface* *Indivisible Lines*, but smaller *Surfaces*; neither are the *Parts* of a *Body* *Atoms*, or *Indivisibles*, but *Particles* indefinitely lesser, or *Divisible* without end. For in things extended we can never come to the very least *Part*, because as long as it is extended, it cannot but be conceiv'd *Divisible*. Whence proceeds that *Axiom*, that no *Quantity* or *Magnitude* can be made of *things* which is not *Quantitative*. If you say that the *Terms* or extremes of *Magnitude* cannot be explain'd without them; I answer, that every *Extended Being* is sufficiently terminated by the negation of any further *Extension*: Nor do I see, what can be more requir'd to the Termination of a *thing*, than that it is no further extended. If it be said that they are necessary to joyn the *Parts* of *Matter*. I answer that neither are they necessary upon that account, because the *Parts* of *Matter* sufficiently hang together without standing in need of a third to link them together.

You will *Object*, that there are some *Particles* in *Bodies* so small, that they cannot be divided; and without question there may be such, as *Atoms*, and the like, which can by no human artifice be made less than they are; and yet no *Body* can deny

the Proper-
ties of an
Extended
Substance.

II.
From the
Extension of
Matter we
may easily
infer its
Divisibi-
lity.

III.
Every Bo-
dy is Divi-
sible.

IV.
There are
no Indivi-
sible Bodies.

V.
An Argu-
ment to
prove
Atoms.

deny these to be *Corporeal Substances*; therefore it cannot be said that a *Body* is divisible into parts that are always further Divisible.

VI.
Epicurus
his Atoms
are Divis-
ible.

I say it is Impossible that any *Body* should have any parts so small as to be Indivisible, because the least part or *Atome* of a *Body* is extended, and therefore cannot be Indivisible. For *Bodies* as such are Extended, without which they cannot be conceived. For suppose an *Atome* lying on a Plain, or three *Atomes* join'd together on a Plain, they must be suppos'd to have Sides, whereby they touch both themselves and the Plain, which is their Extension.

VII.
How Mat-
ter is said
to be Divi-
sible.

Matter therefore is Indefinitely Divisible; that is, the *Mind* of *Man* in the Division of *Matter* can never come to a *Term* where it is stopt from proceeding further; for the least *Particle* will always be extended, and whatsoever is extended must therefore be conceiv'd to have distinct Parts, and what is conceiv'd to have such Parts, must be conceiv'd Divisible; especially if we consider that *God* can do whatsoever we do clearly and distinctly conceive. And tho' *God*, it may be, will have it so, that some *Atomes* should not be actually divided by us, yet we must not say that he hath deprived them of the Power to be divided; for we clearly understand that they can be divided by *God*, as long as we suppose them to be Extended. Therefore *Indivisibles* cannot enter the Composition of a *Body*; forasmuch as nothing is found in a *Body*, that doth not consist of *Length*, *Breadth* and *Depth*.

VIII.
Matter is
Indefinitely
Divisible.

But tho' the Parts of *Matter* be always Divisible, so as that we can never come to the very least of them; yet doth it not follow therefore that the Parts of *Matter* are *Infinite*, but only *Indefinite*. For it is one thing to say a thing is Infinitely Extended; and another, to say it is only Indefinitely so. That is *Infinite* in which there are no Bounds at all, and so *God* alone is *Infinite*: Whereas those things which in some respect only have no End, are better called *Indefinite*, than *Infinite*; such as *Matter* is, which divide it never so much, will still be further divisible. And herein *Magnitude* differs from *Multitude*, because in the latter we come by division to a *Unity* or Indivisible; whereas in the Division of the former, we may still go on, and divide for ever. Because a *Body* cannot be divided into so many Parts, but that every one of them will still be capable of a further Division; and therefore these parts are said to be Indefinitely extended. This will appear more clearly by an *Argument* taken from *Geometry*, because in that *Science* it can be demonstrated, that there are some *Magnitudes* which have no common *Measure*, and therefore are called *Incommensurable*, as are the *Diagonal line*, and the sides of a *Quadrangle* or *Square Figure*.

IX.
What
Quantities
are said to
be Commensu-
rable.

Two Quantities are said to be *Commensurable*, when we can find a *Third*, which is a Part of both the one and the other, that is to say, which measures them both. Thus a *Pace* and a *Rod* are two *Commensurable Quantities*, because we can name a third Quantity, viz. half a Foot, which will measure both a *Pace* and a *Rod*; for the half Foot taken five times, will be equal to a *Pace*, and the same Measure taken twelve times will be equal to a *Rod*.

But if no such third Quantity can be found to measure them both, then those Quantities are called *Incommensurable*. Supposing therefore the Figure *ABCD* to be a *Quadrangle*, it is manifest by *Geometrical Demonstration* that the side of *AB* is in *Commensurable* with the *Diameter* or *Diagonal* *AB*.

Divide we then in our *Mind* the Line *AB* into a thousand equal Parts, and every one of those again into a thousand more, and these last again into a thousand other equal Parts. This Division may be continued for a hundred years, and yet shall we never be able to come to Parts so small, that we can say that the Line *AC* contains a certain and determinate number of them. Which could never happen so, if *Extension* could not be Indefinitely prolonged. For after the Division, by Example of the Line *AB* into the least Parts into which *Extension* could be divided, it would necessarily follow that the Line *AC* contains a certain and determinate number of them. Wherefore we must conclude that every *Extension*, or determinate Portion of *Matter* is Indefinitely Divisible.

It may be oppos'd to this *Demonstration*, that in case all *Bodies* were Indefinitely Extended, it would follow that two *Bodies* of unequal *Magnitude*, would have an equal number of Parts. Yea, moreover if it be granted that one Part of a *Body* be Indefinitely Divisible, there will be as great a Divisibility in one part as in the whole; For Example, in a grain of *Barley* as in the whole *Field* wherein it grew. But this seems very absurd, that there should be as much divisibility in the least part of *Matter* as in the vastest quantity; wherefore Indefinite Partition cannot agree to *Extension*.

To which I answer in the first place, that they are very much mistaken who attribute *Equality* or *Inequality* to a thing Indefinite, these being the Properties of *Finite things* only. For how can those things be call'd *Equal* or *Unequal*, which are Indefinitely divisible, and to the least part of which we can never come? Those things only can be call'd *Equal* or *Unequal*, which we can comprehend, and compare together; but not those which are Indefinitely Divisible, and which our *Mind* can neither apprehend, nor compare together.

Secondly, supposing two unequal *Bodies*, should be divided into an equal number of Parts, yet would it not follow thence that those two *Bodies* were *Equal*; because the Parts of one *Body*, would proportionably be greater than the Parts of the other *Body*, and therefore the Divisibility of one *Grain* would not be so great, as that of the whole *Field* wherein it grew, tho' it be Divisible into as many parts.

Neither it a sufficient argument against this, that some say they cannot comprehend how the least *Body* should be Indefinitely Divisible; for who knows not that there is a vast number of things which cannot be comprehended by the *Imagination*? The famous *ROHAULT* proves this by two Examples, very pat to the purpose, viz. by the Division of *Gold* which is made by the *Gold-beaters*, and the partition of the same *Gold* made by the *Wire-drawers*.

For the *Gold-beaters* of one ounce of *Gold* make 2790 Square Leaves of *Gold*, each side of which contains two inches and ten Lines; and if we deduct hence the Waste Pieces that are cut off,

C c

X.
What
Quantities
are Incommensurable.
Fig. 1.

XI.
The Divisibility of
Matter Demonstrated

XII.
An Objection
against the Divisibility of a
Body.

XIII.
The First
Answer.

XIV.
The Second
Answer.

XV.
The Incomprehensibility of the
Divisibility of Matter
is no Argument against the
Truth of it.

XVI.
The Divisibility of Gold
by Gold-beaters.

which

which almost reach to one half of it, the surface of every Leaf of Gold will be found to contain 1156 square Lines; so that all of them joyned together side by side, will make out a superficies of 3155880 square Lines. And if we add to this the Third part thereof for the Loss in the making, it will follow that the Gold-beaters out of one Ounce of Gold, beat 4270840 square Lines. Seeing therefore this Number includes 159092, the quantity of the Basis of the Cube of one Ounce weight, it is without doubt that that Cube, which contains only five Lines with a Seventh part in height, is at least divided into 159812 square Segments.

XVII.
The Division of Gold by Wire-drawers.

And tho' this Division of Gold into Leaves be very surprizing, yet is it much Inferiour to that which is performed by the Wire-drawers. These have commonly lying by them many pieces of Gold of a Cylindrical figure, being every one of them of 16 Marks weight; one of the most regular of which pieces was shewed to the foresaid Philosopher, the length whereof was of two Inches and nine Lines, so that the Cylindrical superficies of it was of about 12672 square Lines: This Superficies being cover'd with many Leaves of Gold, which put together weighed an Ounce and an half, was through the holes of a perforated Plate, drawn into Wire of the thinness of an Hair. Of this Thred he took 150 Foot, which he found upon exact weighing to weigh 36 grains, wanting a part of a Grain: So that the foresaid Cylindrical Mass, at this rate, must make a Thred of 307200 Foot long; whence follows, that it was drawn out 115200 longer than it was at first, and consequently that its superficies did exceed its first length above 340 times. If we add to this, That this thin Thred may be beaten into a Leaf, and thereby obtain a superficies twice as big as it was before, and so will exceed its first Magnitude 680 times, and consequently make 80616960 square Lines: And that after the whole Thred is thus beaten into a Leaf, the superficies of it is all cover'd with Gold: It follows thence, that one half Ounce of that Metal, whose Leaf is cover'd with Gold, is to that degree attenuated, that the superficies of it consists of 80616960 square Lines. Wherefore seeing that quantity contains 325795 times 26 Lines, and $\frac{2}{3}$, which is the value of the Basis of the Cube of Gold of one Ounce, it necessarily also follows, that the Thickness of Gold, which covers the gilt Leaf, is at last reduced to the $\frac{325795}{4}$ part of the half of the height of one Ounce; so that the quantity of five Lines, with a seventh part, hath at this rate been divided into 651590 equal parts.

XVIII.
Every thing that we cannot comprehend, is not therefore impossible.

And lastly, If we consider that this Division of Gold might still be carried further, if the Metal so extended were not design'd to certain uses, which cannot permit any further attenuation of it; as likewise that there are many Agents in Nature, who carry their work to a greater degree of Subtlety and Tenuity, it will still appear more clearly, that that is not impossible which our Imagination cannot perceive or comprehend.

XIX.
Matter is impenetrable.

Another property of Matter is, Impenetrability, which tho' Negative, agrees to a Body, as well as Divisibility. For since to be Extended, is nothing else but to have Parts distinct from each other, it implies a Contradiction, that one Part should take

up the place of another, or that one Part should be contained in the other, or (which is the same) that one Part should be another. For it cannot be conceived, for Example, that the Part A of an Extended thing, should penetrate the Part B equal to it, without conceiving the middle Part of the Extension of A to be taken away or annihilated; now that which is annihilated cannot penetrate another thing. Besides, since any determinate Body, Ex.gr. of a Foot long, hath all things necessary to the constitution of such a Quantity, there can no other Body of a Foot long be added to it, without making an Extension of two Foot: And to reduce them by Penetration to one Foot, is not so much to joyn one Body to another, as to destroy it; and therefore we must conclude, that Matter is impenetrable, and that Penetration and Extension can never agree together.

Whence it is evidently deducible, that Mensurability, Divisibility, and Impenetrability, are the Properties of Matter, because they always accompany it, and can never be separated from it. For that I call the Essential Property of any Subject, which we conceive to agree with any Subject, and which necessarily follows it: As, it is the Essential Property of a Triangle, that two of its sides taken together are greater than the third; Or, that three Angles are equal to two right ones, because these so agree to a Triangle, as necessarily to accompany and inhere in the same.

XX.
Mensurability, Divisibility, and Impenetrability are the Properties of Matter.

CHAP. V.

Of the Division of Matter into Sensible and Insensible Parts.

THO' Motion be only the Mode of a Body, and cannot be conceiv'd to be without it; yet is it so much conducing to the Beauty and Harmony of the World, that all the Matter in it would be without Form, if it were not divided by Motion, and cloath'd with those Affections we find in the several parts of it. Hence it is the Philosophers tell us, That Nature is the Principle of Motion and Quiet, because by means thereof Material Substances acquire that variety we observe in them. By Motion Bodies get Heat, and by Rest they become Cold. But when Philosophers define Nature to be the Principle of Motion and Rest, they are not so to be understood by us, as if all the variety we find in Matter were the effect of Motion and Rest, forasmuch as that depends also on the Magnitude, Figure and Situation; but only that they are the Principal Attributes of Natural Bodies. For there is no question, but that from the Beginning, Motion made the distinction of Bodies, and gave them those Qualities and Affections, which we find in them. And hence it is, that Sensible and Insensible Parts do arise.

Sensible Parts are these, which being made up of many Insensible ones, do affect the Senses. Insensible are those, which because of their smallness do not fall under Sense, and are only known by their Effects, or the Discourse of Reason.

Neither can we doubt of the Existence of such Parts in the World, if we thrôly examin the Nature of a Body, and consider the Inseparable Properties that belong to it. For every Body is Divisible, so as that we can never come to the last Particle of it; though it be certain, that by continual Division,

I.
Matter is divided by Motion.

II.
Of Parts, some are Sensible, others Insensible.

III.
There are Insensible Parts in the World.

WE

we shall at last come to a part, which because of its littleness, will not be perceived by our *Senses*, and yet will not therefore lose the *Nature* of a *Body*; because as *Division* doth not constitute the *Nature* of a *Body*, so neither can it destroy it. Wherefore, there are *Insensible parts* in *Matter*, which none of the *Organs* of our *Senses* can give us any notice of.

IV.
Fluid Bodies consist of many Insensible Parts.

This appears most of all in *Fluid Bodies*, which consist of such small parts that no *sense* can perceive them. Thus we see that *Flesh*, *Bread* and other *things* are spoil'd by the *Air* and *Water*; but how this is done our Reason only can inform us: for we gather from the effects that some *Insensible Particles* of the *Air* and *Water*, insinuating themselves into the *Pores* of the *Flesh* and *Bread*, do there settle themselves in a manner contrary to their constitution as to *Figure*, *Motion*, *Situation* and *Rest*; wherein the *Nature* of *Corruption* doth precisely consist. For we cannot conceive any *Body* to be corrupted, but by the accession of some foreign parts, which are contrary to those of its first constitution: And forasmuch as these *small particles* are not discoverable by any of the *Senses*, they may well be call'd *Insensible Parts*.

V.
All Bodies cannot affect our Senses.

Neither is it any matter of *Wonder*, that these *Least particles* do not affect our *Senses*; because our *Nerves*, by which we perceive external things, are like to so many small *Cords*, that are compounded of many *particles*, less than themselves, and therefore cannot be shaken by the least of *Bodies*; and consequently cannot carry external *Bodies* to the *Brain*, where the chief *Seat* of the *Senses* is. And I suppose every *Rational Man* will own, that it is much better to judge of what happens in little *Bodies*, not subject to *Sense*, suitable to what our *Senses* perceive to happen in great *Bodies*, than to invent I know not what strange things, which have no likeness at all with the things we do perceive by our *Senses*.

VI.
From our Clashes, Iron, &c. Particles proceed, which no Sense can give us any notice of.

Besides, we do daily experience, that a *Knife* doth certain of its small *Particles* by being *Whetted*, and that many such like wear away from our *Clothes*, neither of which are perceived by our *Senses*. For the *Polishing* of hard *Bodies*, and the wearing away of *Woollen-cloth* or *Silks*, is done by the loss of such *Parts*, as our *Senses*, by Reason of their smallness, cannot discern. Wherefore it is most certain, that there are parts of *Matter* which cannot be discern'd by themselves, tho' being joyn'd with others they can make up a sensible *Body*: This being a thing easily demonstrable by the growth of *Bodies*; and is acknowledged by Divine *PLATO* in his *Timæus* in these Words: Concerning these little *Bodies*, we are to conceive thus, that if they be taken singly by themselves, none of them, because of their *Parvity*, can be seen by us, whereas when many of them are joyn'd, their *Bulk* presently appears.

VII.
We are to Philosophize of Insensible parts after one and the same manner.

Wherefore we are to *Philosophize* alike of *Insensible* as of *Sensible Parts*. For as we own some *Bodies* to be compounded of *Parts*, actually distinct from each other, (as we see small *Dust* in *Stones*, and *filaments* in *Flesh*;) so likewise it is consonant to Reason, to admit other parts of the same kind, which because of their *Smallness* cannot be perceived; and their *Analogy* persuades us to Judge and Discourse of them both after the same manner: Seeing that without them, the *Qualities* and *Ope-*

rations of *Bodies* cannot be explained. For how can I apprehend the cause why *Oil* is more easily congeal'd than *Water*, without conceiving the *Particles* of *Oil* to be hooked and *Branchy*, which makes them more easily to cleave together, than those of *Water*? And that *Water* is more hard to congeal, because its *Parts* are slippery, and united together, as *Eels* are, as shall be said hereafter. And yet no *Body* ever discern'd either the *Parts* of *Oil* to be *Branchy*, or those of *Water* to be figured like *Eels*. And therefore it is evident that in *Natural things*, there must be *Parts* allowed, that are only discernible by the *Understanding* or *Imagination*.

Neither are we from hence to infer, that such *Particles* as these, are *Atoms*, that is, altogether *Indivisible*: For being *Parts* of *Matter*, they must need include *Extension*; and it implies a Contradiction, that what is *Extended* should be *Indivisible*; for every *Extended Being*, hath *Parts* distinct from each other, and consists of *Divers Dimensions*, which cannot be said of *Atoms* or *Indivisibles*: Neither can we conceive any *Insensible Parts* to be so solid, as not to be *Naturally Divisible*: Nor is any *Body* so compact, but that by a strong *Motion* it may be dissolved; or if we should suppose this impossible to the *Powers* of *Nature*, yet we cannot deny *God* the Power to do it; seeing there is nothing else required to the *Divisibility* of a *Body*, but its *Extension*, and that it be *Subject* to those *Affections* which constitute a *Body*, as hath been said before.

VIII.
Insensible Parts are not therefore to be accounted Atoms or Indivisibles.

Moreover these *Atoms* are of several *Figures*; now whatsoever is *Figured*, must have *Parts*, which *Parts* as they cleave together, whilst they are at *Rest*, so are they disjoyn'd again, whenever there is made an impulse upon them, strong enough to overcome their *Rest*. And this cannot but happen in that hurry, wherein the *Particles* of *Bodies* are continually tost to and fro.

IX.
They are Figured.

Wherefore we conclude that there are no *Atoms*, or *Indivisible Parts* of *Matter*, but only *Bodies* of an *Indefinite Littleness*, which are continuous, and by the interposition whereof other *Bodies* touch one another. For the *Sensible Particles* do not properly touch one another, but are rather like *Baskets* made of *Twigs*, which cannot be immediately united together, but borrow all their continuity from the *Insensible Parts*, by the various *Inflexion* and *Disposition* whereof they become *Contiguous*, as shall be hereafter shewn at large.

X.
And are Indefinitely Divisible.

CHAP. VI.

Of the Three-fold kind of Matter, and that there are no more than Three Elements of the World.

THE exactest Method of handling *Sciences*, as to my Judgment, is to deduce the thing under Examination from its first Original, and diligently to search from what *Principles* it doth proceed. This is the common way of *Philosophers*, who do not begin their *Treatises* with *Compounds*, but *Premising* things that are simple, proceed from them, to those that are compounded, and the manner how they are made up of them. This is the way used by *METAPHYSICIANS*, who beginning with

In Sciences we are to proceed from simple things to compounds.

with *Entity* in common, from thence come down to a *Body*, which is its *Species*, and afterwards divide it, into a *Terrestrial* and *Celestial Body*. And the same is observed by *GEOMETRICIANS*, who do not presently consider a *Body* as it consists of three *Dimensions*, but first of all imagin an Indivisible *Point*, which by its course or the diffusing of it self makes a *Line*, which is a *Length* without *Breadth*. Afterwards they suppose this *Line* to move crosswise, whence ariseth an *Extension* bounded by *Lines*; and to this they give the name of *Surface*, which is *Length*, and *Breadth*, without *Profundity*. And lastly from these multiplied ariseth a *Body*, extended in *Length*, *Breadth* and *Profundity*.

II.
God did not proceed thus in the Creation of the World.

Which way of Teaching tho' it be very suitable for the Demonstration of *Natural* and *Metaphysical Objects*; yet did not God make use of it in the *Creation of the World*. For he did not first produce an *Entity* in General, then a *Body*, and last of all *Heaven*, *Earth*, *Plants*, &c. Neither did he first constitute a *Point*, from the *Motion* whereof a *Line* might arise, from *Lines* a *Surface*, and from multiplied *Surfaces*, a *Body*. But tho' I own that the *World* in the first moment of its creation was perfect, and that it was not increased by vicissitude of times, yet it will not be absurd for me to establish some *Principles*, whence we may suppose that *Natural Things* have been produc'd, tho' they were not in that precise manner created by God. Because those things are more clearly known by us, which are deduced from a *Principle*, and by a continual vicissitude are brought forth and encrease, than such as are consider'd in an absolute state of Perfection.

III.
Physicians do the same in their treating of Plants and Animals.

Thus *Physicians* in order to their explaining of the Generation and growth of a *Chicken*, begin with the *Egg*, and shew what parts are daily framed therein, by the Incubation or brooding of the *Hen*. And so they who examine the nature of *Plants*, begin with their first Original and Propagation, and then proceed to the considering of them in their Sprouting, Growing, Blooming and bringing forth *Fruit*. For as *ARISTOTLE* saith in his *First Book of a Commonwealth*, he that takes a view of things in their first Rise, will best of all perceive the Truth of them.

IV.
The first thing suppos'd is, that at the Beginning the Parts of Matter were divided by Motion.

Let us suppose therefore the Matter of the Universe to be put into *Motion*, and that it was divided by God into *Parts*, much of an Equal Bigness, not round (because many round *Bodies* put together, touch one another only in a point, and consequently leave many Empty Spaces) but into *Parts* of another *Figure*, and of a mean bigness between those that constitute the *Heaven* and the *Stars*, which we suppose to be whirl'd round about their own Centers.

V.
The Original of the First and Second Element.

This being suppos'd, it will be easily made out, how the *Elements* came to be; for of whatsoever *Figure* we imagine the *Parts* of the *World* to have been, so they have but several *Angles* and *Sides*, it must follow that by running against one another, their *Angles* must by degrees have been worn away, and their *Figure* thereby chang'd to Roundness. For by an *Angle* we understand nothing else, but that Prominency which hinders a *Body* from being round; which *Angles* being worn off, a *Spherical Body* must thence arise. For *Bodies*, whirl'd by various motions for a long time together,

do at last become round, as appears in those things that are turned. And the parts of this *Matter* are called the *Second Element*.

And forasmuch as a *Vacuum* implies a Contradiction, and that all spaces are fill'd with *Bodies*, there must be some more subtil Matter to fill the intervals that are found between those small round *Bodies*, which is performed by those *Particles*, which like *Shavings*, are rub'd off by Motion from *Bodies*; for they being very slender and flexible, easily accommodate themselves to the *Figures* of the *Bodies* they are contiguous to. Moreover by this *Attrition* or Rubbing against one another, they have obtained a very great degree of *Swiftness*; so as that by the meer force of their *Motion*, they are further divided into innumerable *Particles*, and are sufficient to fill up all the little spaces left between the *Globuli*.

Now tho' this Matter be very subtle, yet we must not think that all the parts thereof, are of the same smallness, as appears in *Sawdust*, or in *Filings*. Wherefore the lesser of those particles will be more easily moveable than the thicker and bigger; and the *Particles* of the *First Element* will move more swiftly than those of the *Second Element*: For tho' they receive their *Motion* from these latter, yet because of the ways they must run through, their *Motion* must needs be accelerated: For whilst the *Globuli* of the *Second Element* pass through streight or right-on, and open ways, they thrust those through narrow and cross ways. And indeed we find by Experience that the narrowness of Passage conduceth much to swift Motion, as we find in a *Bellows*, whence the *Air* proceeds with great swiftness, by reason of the narrowness of its Nuzzle.

But tho' most parts of the Matter be Round, and that the *Particles* that are worn off from them, be such as I have now described, yet we must suppose that many parts of the Matter, having been bigger, and of more irregular *Figures* than the rest, it was more easy for them to join themselves with many others, than to become round; and these are they that constitute the *Third Element*, which we may call the *Element* of the *Earth*, because the parts of it have little or no Motion, whereby they might change their situation with regard to one another; in like manner as we may call the First, the *Element* of *Fire*, because of its subtilty, and the swift agitation of its Parts; and the *Second Element*, that of *Air*, because its Parts are bigger, and less agitated than those of the *First Element*.

But from this supposition, that the Matter of the *First Element*, did at first arise from the hitting together of the *Globuli*, one difficulty does arise, viz. that it seems to follow from hence, that this Matter ought to encrease continually, because the *Globuli* of the *Second* hitting one against another incessantly, must needs strike off some *Particles* from each other, and that consequently the *Sun* and fixt *Stars*, which consist of this *Element*, must be encreased continually by reason of a never ceasing affluence of new Matter.

This Difficulty may be easily answer'd, by considering the mutual *Conversion* of the *Elements* into each other. For from the Matter of the *First Element* sometimes a thick *Body* is made, as may be seen in the *Spots* that grow about the *Sun*, and obscure

VI.
The Matter of the First Element, fills the Spaces that are left between the fore said small Round Bodies.

VII.
The Parts of the First Element are not of the same Bigness.

VIII.
The Rise of the Third Element.

IX.
How it comes to pass that the Matter of the First Element, doth not encrease continually.

X.
Answer.

obscure some part of its light. For if we examine their first Original, we shall find that at the Beginning, they are very thin *Bodies*; which repel the impulse of the *Particles* of the First *Element*, which by running against them, cleave to them, and being condensed by the Motion of the *Suns Substance*, become big and Opaque *Bodies*. And by this means the First *Element*, is turned into the Third, which being afterwards dissolved, becomes again the First *Element* by acquitting its former swift agitation, and by being divided into *Particles* of Indefinite Parvity.

XI.
The Number of the Elements.

Wherefore being resolv'd to deviate from the Sentiments of the *Antients*, since we want other *Latin Words* whereby to express them, we will distinguish the Names of these *Elements* only by Numerals, and call them the First, Second and Third *Element*.

XII.
What the First, Second and Third Elements are.

By the First *Element*, we understand with *Des Cartes*, a most subtil Matter very swiftly agitated, fluid, and keeping to no certain figure, but which suits it self to the Figure of those bodies that are about it. By the Second *Element*, we mean very small Globules, that is, Bodies exactly round and very solid, continually whirld about, and which do not only like the First *Element*, fill up the Pores of Bodies, but also constitute the Purest Substance of the *Aether* and *Heaven*. By the Third *Element* we understand a Matter consisting of thicker and Branchy Parts, full of Angles and unfit for Motion, of which the *Earth*, *Water*, *Air*, and all mixt Bodies do consist.

XIII.
The Definition of an Element in General.

An *Element* therefore Generally taken, is a Formed Primordial Matter, whence the variety or difference of Bodies takes its rise. Or it is a simple Body, of which mixt Bodies are compounded, and into which they are resolv'd again at last. First, an *Element* is said to be a Matter Formed, because *Elements* were at first made out of Matter, by the Introduction of certain Modes into it. It is called Primordial, forasmuch as *Elements* are the Principles of mixt Bodies, not made of any other Bodies, as mixt Bodies are, but immediately produc'd from the Matter from which all variety of Bodies takes its rise, as proceeding only from the various Modification and conjunction of the *Elements*.

XIV.
These three Elements are sufficient for the explaining of all Natural things.

It remains next to shew that these three *Elements* of the *World*, are sufficient to explain all natural effects whatsoever, and that therefore there is no need of feigning any other. This will appear if we consider the several kinds of things in the *World*, for according to their Diversity we are to settle the Distinction of *Elements*. And seeing all Bodies may be reduc'd to three General Heads, just so many *Elements*, and no more are we to look for in the *World*. Now Bodies are either lucid or shining, as are the *Sun* and fixt *Stars*: and these are made of the First *Element*; or Transparent as are the *Heavens*, which transmit the Rays of the *Sun* and *Stars*; and these do consist of the second *Element*: Or lastly, Dark and Opaque, which reflect the Rays they receive from Lucid Bodies, such as are the *Comets* and *Planets*, and these consist of gross and corner'd parts, which as we have said, do constitute the third *Element*.

XV.
Why the Sun is called

For it cannot be doubted but that the *Sun* and the fixt *Stars* are Lucid Bodies, as coming near the Nature of Flame, and exactly resembling all

the Properties of Fire, and therefore they cannot consist of any other Matter save that of the first *Element*: And the *Heavens* are said to be Transparent, and compacted of the Globuli of the Second *Element*, forasmuch as by means of them they transmit the Light to us. Now we must not imagine that these Globuli or Pellets of the second *Element*, are immediately joyn'd together, since that implies a Contradiction; but the subtil Matter runs between them, and takes up the places they themselves cannot fill because of their roundness. The same thing being also to be observed in other Bodies which reflect the Light, for a great quantity of the Matter of the first *Element* doth always pierce and permeate the *Earth* and the *Planets*.

Wherefore three sorts of Bodies are chiefly to be consider'd in the *World*; the *Sun* and the *Stars* which consist of one only kind of Matter; the *Heaven* which includes both the first and second *Element*; and the last or lowest, which contains all the three kinds of Matter, as the *Planets* and *Comets*.

You will say, it may be, that it is an Argument of Rashness and Profaneness to set down another order of conceiving of things, than God himself hath observed in the making of them; and that we cannot look upon things to be the effect of certain feigned Principles of our own which we know were created by the sole Command and will of God.

I answer, that it is no Argument at all of either Rashness or Profaneness, for a Man to distribute those things into many parts, which he cannot conceive all together, and to follow such an order of conceiving of things, as is consentaneous to the Laws of Nature establish'd by God, tho' he knows that God did not make use of this Order in the Creation of things. For otherwise not only all Philosophers, but Divines also would be found blameworthy. For do not Divines divide Gods Decrees into many, which notwithstanding in God are only one most simple act? They link divers Decrees in a certain order together, and suppose some of them to have been before, and others after, tho' indeed there never was any such Series or Connexion of Decrees in God. But who has ever undertakn to blame them for this? Except it be some of those, who that they may seem to be wise, will not stick to find fault with Heaven it self. Now if this may be done without blame in the Decrees of God, which are God himself; much more will it be lawful for us to conceive the Universe of Bodily things (which is different and diverse from God, and made by him in the space of six days) as successively springing from certain Elements by the wise and Powerful disposing of God. And the rather, because if God had will'd to produce this *World* successively from Elements, doubtless he might have done it, without any prejudice to his Power or Wisdom.

The Chymists, accounted by some the only Philosophers, and Natures Secretaries, hold five Principles, Mercury, Sulphur, Salt, Caput Mortuum or Dead Earth, and Phlegm; there being scarcely any Body out of which they cannot produce these several Natures, as they tell us. For that by the means of Fire, or some other Analogous Agent, they can so resolve things, that by separating the parts, whereof they were compounded, they can discern their several Forms and Quan-

D d

led Lucid, and the Heaven Pellucid or Transparent.

XVI.
Things compounded of the Elements.

XVII.
Objection.

XVIII.
Solution.

XIX.
The Elements of the Chymists.

lities. Wherefore the more subtil part which they draw off by *Fire*, they call *Mercury*, *Spirit* or *Aqua vite*; the Thicker and Fatter part they call *Oil* and *Sulphur*; and the most fixed, which is left of all extracted, they name *Salt*. Besides these there remains behind a certain *terrestrial matter*, being the dregs or dross of the Resolved Body, which they term the *Caput Mortuum*, or *Damned Earth*; and a watry and insipid liquor they call *Phlegme*.

XX.
The Principles of the Chymists cannot be said to be first Elements.

These Principles of the Chymists, cannot be said to be the First Elements of things, as not being those things into which Bodies are resolv'd last of all, but such as proceed from them by a prior Resolution, after which they may be yet further resolv'd into much more simple parts, as the most experienced Chymists do confess. It hath been prov'd by a late Experiment, that a thick Oil distill'd from various Plants, hath been so rectified by many reiterated distillations, that at every Rectification an equal Portion of Common Water hath been added to it: And after many Distillations, they have got from it a quantity of Water, impregnated with much volatile Salt, besides a considerable portion of Earth, so that at last only a little thin Oil remained, of a great many ounces; which by more Rectifications might have been wholly resolv'd into *Phlegme*, *Volatile Salt*, and *Earth*. So that neither the *Burning Spirit* of Wine, nor Oil it self, nor *Sulphur*, can be reckon'd amongst the first Principles of things, as being only secondary Concretions, which depend on such as are more simple.

XXI.
The Extracted Salts, are not simple.

Neither can I persuade my self that the Salts extracted out of the Ashes of Plants, &c. are so simple as not to consist of some thing more simple than themselves. For when I consider that *Seafish*, which for a great part, are nourished with *Salt-water*, have not the least taste of Salt; and on the contrary that *Men* and *Beasts*, who do not so much feed on *Salt Things*, do void *Salt Urine*, *Sweat*, and sometimes *Sputtle* too, I am very apt to persuade my self that *Salt* it self is not the first concretion of Parts, but only a secondary, and which depends only on a Mechanical texture.

XXII.
The Chymists do not in this their Enumeration, comprehend all Principles.

These Principles therefore, notwithstanding they are so highly valued by the Chymists, do not comprehend all things out of which Bodies are compounded: For tho' they extract Waters by their Distillations, that is, the most slippery and flexible parts of Bodies, which they ascribe to *Mercury*: Oils also, that is, those Branch-like Parts that do easily entangle and hang together, which they attribute to *Sulphur*; and the remaining very thin parts, that are easily mixt with Water, and incorporate with it, which they refer to *Salt*: Yet all this while they make not the least mention of that subtil Matter, whose Existence we have here owned and asserted, and which is of absolute necessity to the composition of most natural things.

XXIII.
The Parts of Bodies are greatly changed by Distillation.

Moreover, who would own those things to be the Principles of Natural Bodies, which are quite changed, and have got another nature? For *Fire* being extremely active, cannot extract the parts of any compound, without violently agitating, and dividing them into less Parts, which Division cannot happen without a change of their Figure, and by consequence of their Nature. Now

Experience proves that the nature of things is alter'd by *Distillation*; because that after all the Parts into which a mixt Body can be resolv'd, are put together again, that which thence ariseth is not the same with that it was before, but is quite of another Nature.

We may add this also, that the Chymists deceive themselves by making only five Elements; because according to the Method and way whereby they have found out these, they may procure a vast greater number of Elements, yea such as the Mind of Man cannot reach. For the same *Mercury* is not drawn from all Bodies; nor the same *Sulphur*, seeing that which is drawn from *Wine* is very different from that they get out of *Oil*. Neither is it the same *Salt* they extract from all Plants, since that of the *Ash* hath a Caustick Virtue, which the *Salt* of *Oak* hath not. Wherefore we must conclude that *Mercury*, *Sulphur* and *Salt* are no Elements, because Elements are simple, and common to all mixt Bodies.

Moreover it is very probable that these five Principles do only differ by the Texture of their parts; neither do I think that *Oil* differs from *Spirit*, save only in this, that the Parts of *Oil*, are by a long Fermentation, divided into smaller parts, and furnish't with lesser branches, whereby they are less apt to adhere to Bodies, and with more ease flee away from them. That it is so indeed, we may conclude from this noted Experiment, that from Plants and Juices much *Oil* is got before Fermentation, but very little *Spirit*; whereas if you distill them after Fermentation, you shall have much *Spirit*, but a very small quantity of *Oil*.

XXIV.
According to the opinion of the Chymists there are more than five Elements.

XXV.
The Chymical Principles presuppose a certain Texture of Parts.

CHAP. VII.

There are no Substantial Forms really distinct from Bodies.

They that follow ARISTOTLE, or rather his Interpreters, do all agree in this, that there are Substantial Forms, which together with the Matter constitute one Compound. By the name Substantial Form, they understand a certain Substance united to matter, which together with it constitutes a meer Bodily compound. Tho' both these parts are Bodily and Divisible, yet they assign a difference between them; as that the Form is more a Substance than the Matter, because they consider it as Subsisting by it self, and is therefore by them called *Actus* or *Actuality*; whereas they will have the Matter to be only *Potentiality*, which is perfected by the Form, from which also it derives all its Existency. Upon which account Matter is frequently call'd by ARISTOTLE a Non-Entity, a Non-Quiddity, and Non-Quality.

Tho' this Opinion be commonly approv'd of in Schools, and that they are accounted no less than Hereticks that reject it, yet Reason obligeth us to depart from it, and publicly to profess that Substantial Forms are of no use in Natural Philosophy for the explaining of the Principles or causes of natural things; yea, that all Natural Effects can better be explained without them. And the chief reason that persuades us to explode these Substantial Forms, is from their own nature. For there can be no substance that begins to be in the Nature of Things, which is not created by God; forasmuch as every thing, both as to its Essence and Existence depends on him; so that if there be any thing

I.
What the Peripateticks understand by Substantial Forms.

II.
There is nothing new in Nature which is not made by God.

thing that begins to be, we may truly say of it, that it is produc'd by God: But many *Substantial Forms* according to them do daily exist anew, and yet are not suppos'd to be created of God by those that admit them; therefore there is no ground at all for them.

III.
Substantial
Forms can
neither be
produc'd
nor annihila-
ted by a
created
agent.

To confirm this; what becomes of *Substantial Forms*, when they are separated from *Matter*? Do they still continue, or do they perish? If they continue, whither do they betake themselves? What is their *Virtue*, or how do they work, being separate from *Matter*? If they perish, as all do own, by what force are they destroy'd or annihilated? Since *Annihilation*, as well as *Creation*, belongs to God alone; and that it is only the *Work* of an *Infinite Agent*, to reduce an *Existing Thing* to *Nothing*? For every single thing, always continues in the same state, except it be alter'd by an *External Principle*; now it is repugnant to the Goodness of the *Creator* to produce things, that have in themselves the *Principle* of their own *Destruction*.

IV.
There is no
instance in
Nature of
Annihilation.

And after all, none of the Asserters of *Substantial Forms*, can produce one single Instance that ever any *Substance* was wholly destroy'd; but will of its being chang'd into something else, and taking a new *Figure*. 'Tis for this cause only that the *Rational Soul* is said to be immediately created by God, because it is a *Substance*. For a *Material Accident*, according to their Opinion, is not *Created*, but produc'd from the Potentiality of the *Matter*, after the manner of *Substantial Forms*; wherefore, since these *Substantial Forms* are not suppos'd to be created, neither ought we to think them to deserve the name of *Substance*.

V.
These Forms
being ob-
scure no-
thing can
be proved
by them.

This may also be proved another way. For *Substantial Forms* were only invented by the *Peripateticks*, to make out the *Causes* of all *Actions*, that are found in *Natural Things*, whereof they are the *Principles*, from whence they do proceed: But these *Forms* are of no use to the explaining of all these effects; seeing that they themselves own them to be *hidden*, and that their *virtues* are not known to them. For whatsoever is clearly perceiv'd in *Bodies*, the same according to them is deny'd to be the *Form*, which they say lies hid in *Bodies*, and which they own to be imperceptible by the *Mind* it self. Wherefore when they say that some *Action* proceeds from *Substantial Forms*, they may well be reproach'd for having recourse to a *Principle* of *Actions*, the nature whereof they do not conceive, and by consequence neither can any thing of certainty be gather'd from it: Which alone, in my Judgment, is sufficient to reject them altogether, forasmuch as nothing is to be admitted in *Philosophy*, which is not clearly and distinctly perceived and known. For what can be more unworthy of a *Philosopher*, than to make those the *Principles* of *Bodily Things*, which he can neither explain by *Definition*, nor demonstrate by *Experience*, nor conceive in his *Mind*?

VI.
Substantial
Forms the
Refuge of
Ignorance.

Would you take him for a *Philosopher*, who being asked about the *Nature* of *Fire* and *Water*, should tell you that *Fire* is *Fire*, and *Water*, *Water*? For is it not much the same thing, to say that *Fire* and *Water* are such by their *Substantial Forms*? Or would you think him to be an *Interpreter* of *Nature*, who being demanded about the *Phases*, or *Appearances* of the *Moon* or *Venus*, and the

Principles of the *Stars*, would answer, that they proceed from *Forms*, as from their *Inward Principles*? What is this but to call all things by one name, and comprehend them under one and the same *Notion*?

But you'll say, it is dangerous to reject all *Substantial Forms*, forasmuch as this may be an occasion of doubting, whether there be any *Substantial Form* in *Man*, because we see the same operations in *Brutes*, which are perform'd in us. I answer, that the contrary ought rather to be infer'd from hence; for by admitting *Bodily Substantial Forms*, and such as are subject to *Death*, it may be doubted, whether such *Forms* be not also in us, as they hold to be in *Living Creatures*; whereas by utterly rejecting them, we extol the Dignity of *Souls*, by declaring them alone to be *Substantial Forms*, and that all the rest consist only in the *Motion* of the *Animal Spirits*, *Configuration* of *Parts*, &c. as shall hereafter be declared more at large.

But the *Soul* of *Man* being a *Substantial Form*, cannot be an *Argument* to prove other *Substantial Forms*; because the *Soul* of *Man* is a *Spirit*, wholly distinct from *Matter*; whereas other *Forms* are all of them *Material*, and consequently extended: whence we must conclude that they are *Modes* of *Matter*; or if any of them be *Substances*, they must be *Bodies* of a particular Nature, which united to other *Bodies*, constitute *Natural Compounds*.

Wherefore the *Schoolmen* certainly differ from *ARISTOTLE*, when they assert the *Forms* of *Natural Beings* to be *Substantial*. He indeed owns the *Form* to be *idea*, but by this word he doth not mean *Substance*, which belongs to the *General Nature* of *Body*; but *Essence*, which relates to the *Special Nature* of a *Determinate Body*. As for example, the *Form* or shape of *Apollo*, is of the *Essence* of the *Statue* whereby *Apollo* is represented, but yet is not of the *Substance* of it, as the *Stone* or *Wood* is of which it is made.

But they will urge further, and say, that *Brute Animals* differ amongst themselves, but they cannot differ by the *Matter*, because that is the same in all viz. a thing extended in *Length*, *Breadth*, and *Depth*. Therefore there must be a *Form* by which they may be distinguish'd from one another. The Major is proved from *Scripture*, which saith that God created the *Living Creatures* according to their kinds, and the *Fowl* of the *Heaven* according to their kind.

I answer, that we freely grant all this. For the names of *Genus* or *Species* do not always denote *Substantial Differences*, but sometimes only *Accidental ones*: And this way *Animals* do differ, who are differently disposed and moved; much in the same manner as *Clocks* may be said to be distinguish'd, because they have various *Motions* according to the different ways after which they are made. For not only *Substances* differ by *Species* or by *Genus*, but also *Modes* and *Accidents*; for a *Round Figure* doth no less differ specifically from a *Square*, than *Beasts* and *Fowl* do; and yet no body will be so senseless to assert, that those *Figures* differ by *Substantial Forms*; since neither of them include any thing of *Substance*. And so likewise *Beasts* and *Fowl* are said to differ, because *Matter* is variously dispos'd and modified in them.

You

VII.
By admit-
ting Mate-
rial Forms,
it may be
question'd
whether the Ra-
tional Soul be
not of the
same Na-
ture.

VIII.
The Soul
of Man be-
ing a sub-
stantial
Form, does
not prove
that there
are other
Substantial
Forms.

IX.
Neither did
Aristotle
ever own
them.

X.
An Objection
on which
from the
Distinction
of Living
Creatures.

XI.
Solution.

XII.
Another
Objection
drawn
from the
Difference
of Bodies.

XIII.
Solution of
the Diffi-
culty.

I.
What the
Peripate-
ticks Un-
derstand by
Accidents.

II.
They Con-
found Sub-
stance with
Accidents.

III.
If Acci-
dents be
Real En-
tities they
may exist
by them-
selves.

You will say that there are many Bodies in the Universe which do essentially differ, as Honey, and Wormwood; and that this Essential Difference cannot proceed from any thing, but from Substantial Forms; seeing that the Accidents that are in Honey and Wormwood, as to their Figure or Disposition of Parts, may be changed, whilst the Honey and Wormwood still continue the same.

I answer that Honey is constituted such as it is by its Form, and so essentially differs from Wormwood: But that this Form is a Substance I utterly deny, because the difference of these two, is only from the different configuration, situation, &c. of their Parts. For tho' it be accidental to Matter in general, to have the configuration of the Parts of Honey or Wormwood; yet is it essential to Honey and Wormwood, to have such Modifications, to make them such Bodies. But of this more hereafter.

CHAP. VIII.

That there are no Qualities, or real Accidents distinct from Substance.

THE safest way to arrive to the knowledge of those things we enquire after, is to separate them from one another, and by this means distinguish what is obscure, from what is clear in them. But in the Observation of this Rule, we must have a care not to increase the number of Objects, or to assign Existence to such things, which indeed cannot exist. Which some seem to have done by distinguishing Qualities and Accidents from Substances, and taking them for Real Entities, having a distinct Nature from the Subjects in which they are found. For they have defined them to be Things adventitious to Subjects, and that are by Nature distinguished from them. And will have their Essence to consist not in an Actual, but Aptitudinal inherence, to shew that Accidents may exist separate from their Subjects.

But certainly they are in a great mistake, seeing that they confound the notion of an Accident with that of Substance, whatever they may say to the contrary. For every thing that is real involves an Aptitude to exist, and therefore is a Substance; seeing by a Substance nothing else can be understood, but a Thing, which stands in need of the Concourse of God only to exist; which how truly it agrees to an Accident, no body will deny, that owns an Accident to be something Real, and that it can exist separate from its Subject. Moreover, whatsoever is evidently and distinctly known by us, the same is true: But I clearly understand an Accident to be a real thing, and that it can exist independently of its Subject; Therefore an Accident is to be called a Substance; forasmuch as nothing else is contained in the Conception of a Substance. For no stronger Argument can be alledged to prove that two Things are the same, than that they have one and the same Definition.

But you will say, that Accidents are very weak Entities, which stand in need of a Subject to support them, and that therefore they do not deserve the name of Substance. If this Answer were sufficient, it might as well be said that the Animal Spirits, and all insensible Particles of Bodies, ought to be reckon'd amongst Accidents, because they

also want a Subject to support them, and from whence they have their permanency. It is sufficient to the nature of a Substance, that it be an Entity fit or apt to exist. Now forasmuch as Natural Accidents, which ARISTOTLE defines in his first Chapter of Prædicaments, are such Entities, and that Existence is no where to be found but in those Entities, we may well say that they subsist of themselves.

And whereas they say that Accidents cannot naturally exist separate from Matter, but only by the Divine Power; this is nothing to the Purpose; for Gods Power doth not destroy the Nature of things, nor impart any new thing to them. Wherefore, if every thing that can Naturally be separated from its Subject be a Substance, then that also which by the Almighty Power of God can be without a Subject, may as well deserve the name of a Substance. And as to what they say that Accidents separated from their Subjects, do by a natural propensity require to be restored to them again, neither will this do them any service at all: For as a Bodily Substantial Form, which supernaturally can exist separate from its Subject, whence it is brought forth, doth not therefore cease to be a Substance, because of its natural propensity to be united to Matter; so neither doth an Accident, that admits the Definition of a Substance, cease to have the Nature of a Substance, tho' by a Natural Propensity it requires to be placed in a Subject. Neither will this Exigence ever be able to hinder an Accident from being look'd upon as something Subsisting, which is sufficient to constitute the Nature of a Substance.

I cannot imagin why the Peripateticks take so much pains to introduce Accidents into the World, when if there were any such, they could not be perceiv'd by any of our Senses: For every Sensation is perform'd by Contact; now nothing but the Superficies of Bodies can be touch'd; and that Surface which is touch'd, is not a Real Accident, as they falsely imagine, but only the Mode of a Substance, as consider'd without Profundity. But they will say that Real Accidents are to be admitted in order to the explaining of Sensation: But neither is there any Necessity for this; since nothing is requir'd to the moving of our Senses, besides the variously disposed Superficies of Objects: For we may easily understand how from the different Magnitude, Figure and Motion of the Particles of one Substance, divers local Motions may be produc'd in another: But we cannot conceive, how by them any such thing should be made as a Real Accident is, that hath power to produce local Motions in other Bodies.

The thing will become more evident by an Example: What is it in a Watch that measures the hours? Is it any Faculty or Power distinct from the Watch it self? Certainly 'tis nothing besides the Magnitude of the Parts, the Fabrick of the Wheels, the Figure of the Spring, and other Mechanical affections that produce all those certain and constant Motions. Is there any virtue superadded to beaten Glass, which wounds the Membrans of the Guts, and makes it Poison? Not at all: For the same Glass being ground to a very fine Powder may be taken into the Body without any danger at all; and the Power in Beaten Glass, of hurting the Bowels proceeds only from the Firmity or hardness of its

IV.
A Real
Accident is
a Substance,
if the De-
finition of
Substance
agrees with
it.

V.
Real Acci-
dents are
useless in
Natural
Philosophy.

VI.
This is
illustrated
by the Ex-
ample of a
Watch and
Beaten
Glass.

Parts,

Parts, and the Figure of them, not from any Occult Quality, nor from a Faculty distinct from it, proceeding from the Glass it self.

VII.
Whatsoever
exists is
Substance,
not Acci-
dents.

Real Qualities therefore, as they call them, are not to be admitted by a *Natural Philosopher*, as being repugnant to sound *Philosophy*, and cannot be understood, even of those, who will needs have them distinct from their *Subjects* as if they were *Real Entities*. For who could ever conceive a thing to be distinct from another, in which it is, and yet to have no *Existence* but what is dependent upon it? For every thing hath its own proper *Existence*, and whatsoever hath *Existence*, is without our thinking, in the nature of things, and therefore is no *Accident*. It seems a contradiction in *Terms*, to say that a thing exists, and yet wholly stands in need of the help of another that it may be; as will be evident to him that minds his own *Thoughts* and *Conceptions*, rather than the *Words* that are tolt in the *Schools*.

VIII.
Substance
only, is an
Entity.

Accordingly *ARISTOTLE* himself *Book 7. Metaph. chap. 10.* expressly asserts that *Substance* alone doth properly deserve the name of *Being*, or *Entity*; and that a *Quality* or *Accident* is not so much an *Entity* or *Being*, as the *Entity* of an *Entity*, or the *Mode* of a *Being*. For what is more contrary to Reason, than that that which hath no *Essence* of its own, but borrows its *Existence* from another, to which it is joined, should be reckon'd amongst *Entities*? For as one thing only is said to be found or *Healthy*, viz. an *Animal*; and all other things are said only comparatively to be so, so far as they have any reference to the nature of an *Animal*; so likewise we are to suppose, that *Substance* alone, according to propriety of *Speech* is an *Entity*, and all other things *Analogically* only, and with reference to that. Wherefore *Quality* in General is thus to be defined: *A Mode of a Substance*, or a certain adaptation of the *Parts* of a *Body* according to *Motion*, *Situation*, *Figure*, *Magnitude* and *Rest*. Forasmuch as from these a *Body* is denominated such like, and the *Quest on What-like a thing is*, may be fitly answer'd.

IX.
Wherein
the Nature
of Acci-
dents or
Modes doth
consist.

I am not ignorant that the Assertors of *Real Qualities*, do support their Opinion by *ARISTOTLE'S* Authority; but I can never believe that so Great a *Philosopher* by *Qualities* did understand *Real Accidents*, but that thereby he only meant (as far as can be gather'd from the Examples he alledgeth) that there are divers dispositions of *Parts* in one *Body*, from what there are in another. In which sense I readily admit them, as supposing them only to consist in the *Motion*, *Rest*, *Configuration* and *Situation* of *Parts*. Thus *Heat*, for Example, is nothing distinct from the *Fire*, but is the very *Substance* of it, or the *Flowing* of its *Particles*, which penetrate and divide the *Wood* or any other *Matter*: So *Figure* is the *Body* it self, with regard to its being bounded by other *Bodies* from any further extension. So likewise *Hunger*, *Thirst*, *Standing*, and *Sitting*, are nothing else but various Affections or Mutations of a *Body*, which we consider as *Modes*, and not as *Real Accidents*, which may be separated from it.

X.
Agility,
Soundness of
Body and
Beauty are
not any

And the like we are to conclude concerning *Agility*, *Health*, *Beauty*, &c. For *Agility* is nothing else but a due Proportion of *Spirits*, and strength of the *Nerves*, that procure *Bodily Motion*. *Health* is nothing else, but a convenient

Temperament of the *Humors*, and Aptness of the *Members* of the *Body*, in that state which Nature requires. *Beauty* is a fit disposition of *Members* and *Colours*, in a due Proportion to each other. And whosoever pretends *Qualities* to be any thing else, I dare aver that he doth not understand what he asserts; seeing they cannot afford him any notice towards the apprehending of them, or any particular *Idea* concerning them. Nay he cannot so much as know wherein they consist, as shall be made evident hereafter in the case of *Heaviness*, *Motion*, and such like. Except he looks upon them as certain little *Souls*, under the notion of *Spiritual Beings*, which belong to *Bodies*, and perform the same in them, that our *Souls* perform in ours, when they move them.

A Modern *Philosopher* explains this point, by the Example of a *Habit*, which is defin'd to be an *Adventitious Quality enabling the Subject to work with ease*. Or, to use his *Words*; The *Vigor*, *Ability* and *Readiness* of a *Natural Faculty*, acquired by repeated *Acts*, enabling one to do that better, more readily and certainly, which he hath several times tried to do. For by frequent repeated *Actions* (or by an Extraordinary vigor communicated by *Gods Special Grace*) *Habits* are got, which are no new things superadded to our *Soul*, but only *Modes*, as when by frequent dancing, the *Feet* acquire a great degree of nimbleness, which Modifies the natural moving faculty.

We see in a *Watch* that when the *Wheels* are but newly made, and rough, they move more slowly, which afterwards when the *Surface* of them has been worn and made smooth by long continued *Motion*, move more swiftly: Whence it is that frequently old *Watches* do Anticipate the time, and make shorter hours. But who will say that by this smoothing of the *Wheels*, any thing hath been added to them, besides a *Modification*? since all the change that hath happened to them is, that the *Wheels* are become more smooth and polished, and their *Motion* swifter than it was before. And the same must be said of our *Mind*, when a *Habit* is added to it, that it can now understand that more readily and easily, which before it naturally did more slowly and difficultly, which plainly is nothing else but a *Modification*, and not any new thing added to our *Understanding*.

Besides, if *Accidents* be *Real*, we shall never be able to know what *Accidents* belong to a *Body*, and what to a *Spirit*. For if *Accidents* have no Affinity with their *Subjects*, save this only, that they inhere in their *Subjects*, and yet are really distinct from them, we shall not be able to gather from the Perception of an *Accident*, whether the *Substance* in which it is, be *Material* or *Spiritual*; that is, from the *Colour*, *Figure* and *Magnitude* we shall not be able to conclude that it is a *Body* rather than a *Spirit*; neither shall we from *Understanding* and *Willing*, which are the *Modes* of a *Spirit*, be able to conclude, that the *Substance* endued with these *Accidents* is a *Spirit*: No more than from the Nature of a *Body* to which the *Soul* is joined, we can conclude that the *Mind* is a *Body*, or the *Body* a *Mind*.

Forasmuch therefore as we are ignorant wherein the Nature of a *Quality* doth consist, and can frame no *Idea* of it, it is unbecoming a *Philosopher* to make use of that for the explication of *Natural Effects*.

new things
superadded
to a Body.

XI.
Habits are
no new
things su-
peradded
to the Soul.

XII.
The same
thing shew-
ed by the
Example of
a Watch.

XIII.
If we ad-
mit Acci-
dents to be
Real, we
shall not be
able to
know whe-
ther they
belong to
Matter or
Spirit.

E e

Effects.

Effects, which can neither be understood, nor defin'd, nor made out by *Experience*. But why then, may some say, are these *Qualities* admitted by the *Peripateticks*? Why, for no other reason but to mask and hide their own Ignorance, and that by fine words they may seem to know that, which indeed they do not. Accordingly if a *Man* ask them why such *Medicaments* purge, they will tell you, because of their *Specifick Quality*. Why doth the *Loadstone* draw *Iron*, or turns it self towards the *Pole*? Because such is its *Occult Quality*. How comes it to pass that the *Bones* of *Mermaids* stop *Bleeding*? Because they are endued with such a *Quality*. O excellent *Philosophers*! who know that the *Loadstone* turns it self to the *Poles*, that *Fire* is *Hot*, that a *Coal* is *Black*, *Honey* sweet, *Gall* Bitter, because of inbred *Qualities*, but altogether unknown and conceal'd from us.

XV.
What we
are to Under-
stand by
the Name
of Accident.

What are we to understand then by the word *Accident*, if they be not things distinct from the subject wherein they are? I answer, It is that which happens to an extended Substance; and therefore an *Accident* is not any thing *Real*, but a *Mode* depending on the *Substance*. Thus because we conceive the Roundness of a Piece of *Wax*, as having a dependent *Existence* on the *Wax*, we call it a *Mode* or an *Accident*. These *Accidents* have got several names, according to the several ways of our considering them; for as *Substances* are affected and alter'd by them, we call them *Modes*; as from them they are denominated such like, they are call'd *Qualities*, and when we only generally consider them as being in any *Substance*, we name them *Attributes*.

XVI.
An Acci-
dent or
Mode can-
not exist
without its
Subject.

Whence it is evident that an *Accident* or *Mode* cannot exist without its *Subject*, nor pass from one *Subject* into another: for if that could be, it would follow, that when it was in the first *Substance* it did not absolutely depend on it, which implies a contradiction.

CHAP. IX.

What Intelligible Forms may be attributed to Natural things.

I.
Matter be-
ing Passive
of it self,
must have
some Forms
by which it
may act.

Matter being of it self sluggish and idle, and *Substantial Forms*, and *Real Accidents* having been rejected by us, we must take care to furnish it with some *Forms*, that may give to it variety and Distinction. For since *Matter* is a *Passive Principle*, we are to procure it some *Principles* whereby it may be enabled to procure its effects: Which we shall easily meet with, if leaving the *Schoolmen*, we shall betake our selves to the *Mathematicians*, and build our *Philosophy* on their *Principles*.

II.
What are
the Forms
of an Ex-
tended Be-
ing.

For having defin'd a *Body* to be a *Substance* extended in *Length*, *Breadth*, and *Depth*, it remains, that in Imitation of them we consider in it *Magnitude*, that is, a determin'd Measure, which is call'd *Continuus Quantity*, or the number of its parts which is *Discrete Quantity*. Secondly, *Figure*, or the bounding *Extremities* of the *Matter*. Thirdly, its *Situation*, or disposal amongst other *Bodies*. Fourthly, its *Motion*, or change of *Situation*. Fifthly, its *Rest*, or abode in the same place. So that *Quantity* or *Magnitude*, *Figure*, *Situation*, *Motion* and *Rest* are the *Intelligible Forms* of all

Bodies, whence their *Rise*, *Nature* or *Essence*, and *Properties* do depend. A *material Form* therefore is nothing else, but a *Complexion* of *Affections* and *Modes*, that are accommodate to a thing, and to its performing several *Actions*. Which *Form* in a sound sense may also be call'd *Substantial*, as being the *Form* of a *Substance*, that is, of the *Matter*, which it informs and perfects. For *Forms* give to all *Natural Bodies* *Substance*, and *Essential Difference*, and are the Springs of the operations of every thing, and therefore may well be called *Substantial*: They are contained in these Verses.

Mind, Measure, Rest, and Motion,
With Figure, and Position,
To Matter join'd, the Causes be
Of all what here below we see.

The variety of these *Modes* is the Mother of Different things, and their *Conjunction* the *Dispositive Principle* of all *Actions*; which Art the Imitation of *Nature* abundantly teacheth us: For *Artificial things* do no otherwise differ from *Natural*, than that these for the curious contrivance, multiplicity and fitness of *Organs* do exceed the Former, and thereby witness the Transcendent excellence of the *Artificer* that made them.

III.
From these
the Di-
stinction of
things and
their Affi-
ons do pro-
ceed.

Now that these *Modes* are the *Forms* of *Material things*, will appear more clearly, by assigning those conditions to them, which belong to *Forms*.

IV.
The Condi-
tions of
true Forms.

The First is, that the *Form* be proportionate to the *Matter*, so as to Determine and Define the same, which some call *Actuating*.

The Second, That as there is but one and the same *Matter* of all *Bodies*; so likewise there be but one common *Form* to them all, and such as shall affect them all alike.

The Third, That as all do own *Matter* to be a thing Extended and Divisible; so the *Form* also may be a thing known to all, and of the *Existence* whereof there can be no doubt.

The Fourth, That the nature of it be so clearly defined, that the notion may be as distinct, as is that of the *Matter* which it affects and distinguisheth. For it is the nature of *Principles* to be so clear and evident, that when the mind heedfully considers them, it cannot question their *Truth*.

Now that these I have mention'd are the true *Forms* of a *Body*, or that they impart a certain *Mode* of Being unto the *Matter*, will appear from hence, because all the foresaid conditions of *Forms* agree with them. As to the First, it is evident, that *Matter* derives its Distinction from *Quantity*, *Motion*, *Figure*, *Situation* and *Rest*: According as more or fewer of these are found in it. For the Diversity of *Matter* depends on *Motion*, without which there can be no separation of *Parts*. From *Quantity* it derives the *Mode* of its Extension. *Figure* furnisheth it with proportionate *Extremities*. To *Situation* it owes its position amongst other *Bodies*, whether upward or downward, forward or backward. Lastly, by *Rest* it continues in the same place, till by a stronger it be remov'd.

V.
These Con-
ditions
agree to
Quantity,
Motion, and
the rest.

As to the second condition it appears also that these five *Forms* are common to all *Bodies*, because they affect and diversifie not only *Earthly*, but also *Heavenly Bodies*. For *Heavenly Bodies* have their *Magnitude*, observe their distance and *Situation*,

VI.
Magnitude
Motion, &c.
are common
to all Bo-
dies.

tion, some of them being moved about their *Axis*, others about their own *Center*, and are bounded by *Figures*, which by the jostling of other *Bodies* against them they change and vary.

VII.
Forms exist
in Matter.

And according to the Third Condition, these *Forms* are apparent to, and own'd by all, to be in *Natural Things*, as being plainly discernible by us. For who is so dull and stupid as not to discern the *Magnitude*, *Figure* and *Motion* that is in *Bodies*, which are so obvious to his *Senses*? Neither in this do unlearned Men differ from those that are learned; since both own them alike; only the Unlearned considering chiefly their outside, judge them to be *Affections*; whereas the Learned searching more deeply into the Works of *Nature*, find them to consist in the insensible structure of the *Parts*, that by their smallness are not subject to our *Senses*.

VIII.
The Definitions
of Forms are
Evident.

As to the Fourth Condition, we cannot question but that the Definitions of these *Modes*, are easily deducible from this discourse, and are obvious and evident, not only to our *Senses* and *Reason*, but experience also.

IX.
Tho' these
forms are
not Substantial,
yet are they Essential
to some
Bodies.

Tho' these *Principles* be only *Modes*, and like *Accidents* are attributed to a *Body* generally taken, yet may they be said to be *Essential* to the *Works of Nature*. For it is no contradiction to say that the same thing may be *Essential* and *Accidental* in diverse respects: Thus *Wisdom* is *Accidental* to a *Man*, but *Essential* to a *Wise Man*. *Sense* is the *Property* of an *Animal*, and yet is a *Genus*, with respect to the *Sight*, *Hearing*, *Smelling*, &c. In like manner, tho' *Quantity*, *Figure*, *Motion*, *Situation*, and *Rest* happen to *Matter* in *Common*, yet this doth not hinder but that they may be *Essential* to some Portion of it. Thus it is *Accidental* to *Iron* to be terminated by several *Figures*, as to be *Round*, *Square*, *Sharp*, or *Blunt*; whereas in a *Knife* the *Figure* constitutes its *Form*, and distinguisheth it from other things. For tho' *Iron* may be conceived without this or the other particular *Figure*, yet a *Knife* cannot be a *Knife* except it have such a determinate *Magnitude*, *Figure*, &c. So likewise *Roundness* is *accidental* to *Wood*, but is *Essential* to a *Wooden Bowl*. And in a *Clock*, *Magnitude*, *Figure*, *Situation*, the *Motion* of some parts, and the *Rest* of others, are *accidental* to the *Brass* or *Iron*, because without them they are still *Brass* or *Iron*; but a *Clock* can never have that name, without them.

X.
The Difference of
Bodies depends on
the Modification
of their Parts.

So that the whole *Difference* of *Bodies* doth depend on the *Modification* of their *Parts*, which are distinguish'd according to the variety of their *Magnitude*, *Figure*, &c. as their *Identity* or sameness consists in the agreement of those *Modes*, and their observing the same *Proportion* amongst themselves. Wherefore, tho' a *live Man*, and the *Statue of a Man*, be alike in outward appearance, yet cannot they be said to be the same, because besides the *Soul*, which is in a *Living Man*, there is also great diversity of *Parts*, not only as to their number, but in respect of their *Magnitude*, *Figure*, *Connexion*, *Rest* and *Motion*.

XI.
Objection,
that the
operations
of Matter
do not depend
on these Accidents.

But it will be objected, that these *Modes* cannot produce so many *Effects*, forasmuch as all *Actions* are attributed to the *Subjects* themselves, and not to the *Accidents*, which only operate by virtue of the *Substance*.

I answer, that we acknowled no other *Subject*, but *Matter* furnish'd with *Magnitude*, *Figure*, &c.

for *Matter* being passive, cannot operate, but by their efficacy. And tho' indeed *Matter* do not derive its *Essence* from these *Modes*, that is, tho' they do not make it to be a thing, yet do they cause it to be such a thing. Thus that a *Pen* is fit to write withal, and a *Key* proper to open a *Lock*, proceeds only from their *Disposition*, *Figure*, *Motion*, &c. for when these are taken away, they are no longer useful. Wherefore, *Accidents* do not operate, by *Virtue* of their *Substance*, as the Schools will have it; but the *Substance* rather works, by a *Virtue* borrow'd from its *Accidents*. Thus diverse *Weights* are lifted up by a *Beam*, according to the *Difference* of its *Situation*: Neither would *Iron* cut, if it were not provided with a fit *Figure* and *Magnitude*.

If you object that these *Principles* are not sufficient to explain all the *Phænomena* of *Nature*, because it cannot be made out by them, how *Warm Water* grows *Cold*, forasmuch as this change cannot proceed from the *Different Disposition* of the *Water*.

This change may very well be explain'd by our *Modes*, supposing *Heat* to be nothing else but a *Strong and various Agitation* of *Particles*: For the *Water* by communicating its *Heat* to the *Air* and the *Neighbouring Bodies*, easily loseth it, except other succeed in the room of that which is lost; for by this means the *Water* is at length depriv'd of its strong agitation, and consequently returns to its former coldness.

Hence it is evident that the *Powers* of *Bodies*, or their *Faculties* of *Acting*, are nothing else but the *Magnitude*, *Figure*, *Contexture*, &c. of the *Parts* of *Bodies*: For by these all the effects we see in *Nature* are produced.

The *World* therefore is to be consider'd as a wonderful, and most Artificially contriv'd *Machine*, not the parts of it taken severally, but as joined and orderly complicated together. For as in a *Watch* we see many *Motions* performed only by the *Contexture* of its *Parts* and *Wheels*; in like manner all the *Agreement* or *Likeness* and *Difference* of *Bodies* proceed from their *Mechanical Affections*, viz. *Motion*, *Figure*, *Magnitude*, &c. As for example the *Power* the *Sun* hath, of attenuating *Water* into *Vapors*, of softning *Wax*, and *Hardning* of *Clay*, and of producing many other *Effects*, is not deriv'd from any new *Entities* added to it, or *Distinct Qualities*, but from its *Heat* only, which consists in the swift *Motion* of its *Insensible Parts*, which produceth several *Effects*, according to the different *contexture* of the *Body* it works upon.

It is evident from what hath been said, that there are only two *Principles* of *Natural Things*, viz. *Matter*, which is the same in all *Bodies*, and the *Form* whereby one *Body* differs from another; since it is certain that *Privation*, which the *Peripateticks* add to the two foregoing *Principles*, doth not deserve that name, as being a *Non-entity*, from which consequently nothing can proceed.

Hitherto we have consider'd the *Nature* of a *Body* in *General*: We must next enquire into its *Affections*, which are nothing else but *Qualities*, *Attributes* and *Modes*, which agree to *Bodies*, according as they are said to be in this or the other state or condition; such as are those which we are

XII.
Answer.

XIII.
How hot
water be-
comes cold.

XIV.
Answer.

XV.
Natural
Power con-
sists in the
Disposition
of Parts

XVI.
The World
is to be
look'd upon
as a Ma-
chine.

XVII.
There are
no more
than two
Principles
of Natural
things.

XVIII.
Of the Af-
fections of
Bodies.

next

next to treat of, viz. Rarity, Density, Heaviness, and Lightness, &c. wherewith a Body is variously affected or indued.

CHAP. X.

What Rarefaction is, and how it is performed.

I. Rarefaction cannot be performed without the entrance of new Matter.

It appears from what goes before, that Extension is something that is not distinct from Matter, and that the one cannot be increased, but the other must be so likewise. Hence it follows, that in Rarefaction and Condensation the Constitutive Quantity of Bodies, is neither increased nor diminished; but only that in Rarefaction, the parts that were before United, are distended, so as some intervals are left between them, which are fill'd up by the entering in of some fluid and moveable Body; as is manifest in a Spunge swell'd with Water; and that on the contrary in Condensation, the separated parts are more closely united, by expulsion of those Bodies that fill'd up the Intervals; as appears in a Spunge out of which the Water is squeez'd.

II. What a loose and, what a close Body is.

A Thin or Loose Body is that whose parts are intercepted by Spaces fill'd with some foreign Matter, which afterwards may become a Close Body again by expulsion of the more subtil Matter, entered from without, by which means the parts come close together. Thus Boiling Water is rarefied in a Pot over the Fire; for we find that when it begins to boil, it swells up into Bubbles, which could not be, but by the entrance of some External Matter, causing them to swell and be extended: and the same is the case with Water, when it is turned into a Vapour.

III. An Object is rais'd from the Rarefaction of Water.

You will say, that in this case of a Vapour we perceive indeed that Extension is increas'd, but no access of any new Matter: Wherefore it is without ground to say that Rarefaction is performed by the addition of some other Body.

IV. Answer.

I answer, that in a Vapour there is no more Extension or Quantity perceived, than there was in the Water before its Resolution, because in this change nothing else happens but a Solution, Division and Separation of those parts, which before were more closely joined together; For he who at a distance beholds the Vapours that rise from boiling water, takes them to be a continuous Body; but if he take a nearer view of them, he will find them to be nothing else, but a crowd of innumerable small Particles, which separate and come between many other Heterogeneous Bodies. Wherefore where we find any Body dilated, we must conclude that it is by the access of some new Matter.

V.

The Bodies which enter the Pores of Bodies are of the same nature with those that strike our Senses.

But what kind of little Bodies are these, which enter the Pores of Rarefied Bodies, and which are expell'd when they become close and hard again?

I answer that they are the same in Substance with those Bodies which are seen and felt by us; save only that they are more subtil and fluid, and so are fit to penetrate and fill the Pores of other Bodies. For according to our Hypothesis, there are some Particles in the Air and other Bodies so subtil, as to be able to pierce Gold, Diamonds and the most Solid Bodies that are.

You will say, that we do not find that the Pores are dilated in Rarefaction, nor that any New Bodies enter into them. But to this I answer, that all Bodies do not affect our Senses, by reason of their extream littleness. We know that a Vine in the Spring grows, and becomes extended to a further Length; which Extension could not be, but by an addition of Bodies, which dilate and stretch out the Substance of the Vine. And yet no Man ever perceiv'd these Bodies. We never saw the Air, and yet know that it is extended throughout the whole World. Wherefore neither in Rarefaction are we to deny Bodies to enter into the Pores, because we do not see them; but are to judge of what happens in these little Bodies, by what we see happens in the greater.

From this Explication of Rarefaction it is evident, why Metals and other Hard Bodies are not rarified without difficulty, but soft Bodies very easily, because the parts of them are readily separated and admit other Bodies, whereas hard Bodies, as Iron, &c. are not without great violence dissolved, and by that means hinder other Bodies from entering between their parts, wherein the Nature of Rarefaction doth consist.

You'll say that in Rarefaction not only that Body is rarefied whose Pores are dilated; but also all the subtil Matter that enters them, which cannot be without the introduction of other Bodies, and these again by the Introduction of others, and so to infinity, which is not to be admitted in Natural Causes.

I answer, there is no inconvenience to say that Bodies that have Pores, become rarefied by the Intromission of others, and these again by the Intromission of other lesser Bodies, so we do but admit that there are some Bodies, which because they have no Pores cannot receive other Bodies, and that there are such is not to be doubted, especially by them who hold Quantity to be indefinitely extended: For they must acknowledge that the Parts of Matter may by Division be made so small, that they cannot be further divided but by our Thought.

You'll say that the more loose or Rarefied a Body is, the more Pure it is also; as the Air is, when it is free from Clouds and Vapours: But now the Purer any Body is, the less it admits the mixture of any External Bodies; therefore Rarefaction is not made by the Introduction of other Bodies.

The Major of this Argument is to be deny'd; for Pure and Rarefied are not one and the same thing: That is Pure which is free from any mixture of foreign Matter: As the Air is said to be pure, when it is not obscur'd by Clouds or Exhalations. But a loose or Rarefied Body involves the mixture of External Bodies, and cannot be understood without it; as a Spunge that is swell'd with the Intromission of Water.

The ordinary Cause of Rarefaction is Fire; for the subtil Particles whereof it consists, being in continual Motion, easily enter the Pores of other Bodies, and dilate them. Hence it comes to pass that Water, which hath long boiled over the Fire, is more easily congeal'd than cold Water newly taken out of a Well or River, because the most subtil parts of it, which by their Agitation and Motion hinder'd Congelation, are evaporated in the Boiling. Neither are liquors only, but Metals, and other solid Bodies somewhat distended by Heat. Thus we find that melted Metals swell somewhat;

VI. There are Bodies that are not perceptible by the Senses.

VI. Why Metals are not rarefied.

VIII. It is not necessary that all the Parts of Matter be rarefied.

IX. There are some Particles that do not admit Rarefaction.

X. The Distinction between a Pure and a Rarefied Body.

XI. Answer.

XII. Fire is the ordinary Cause of the Rarefaction of Bodies, whether they be liquid or solid.

and that it is common with *thread* dipt in *Brimstone* to cut off *Glasses*; because the Parts of *Glass* being put in *Motion* by *Heat*, require a larger *Room*, which they cannot obtain, without driving away the parts that are continuous to them.

XIII.
The first
Corollary
from what
hath been
said before.

From what hath been said it is evident First; that the *Rarefaction* of *Air*, *Smoak*, *Vapor* and such like *Bodies*, are nothing else but a separation of the *Terrestrial Particles*, caused by a swift *Motion*, and the ingress of New *Celestial matter* into the Spaces left by them. And that the *Condensation* of them, consists in a more intimate union of the said *Particles*, caused by the decrease of *Motion* or *Heat*, the Intervals whereby they were separated growing lesser, or being taken away, which when ever it happens, the *Body* thereby becomes so close and compact, that it cannot be made closer.

XIV.
The Second
Corollary.

Secondly, we may infer hence that a greater or less *Extension* in *Bodies* that are rarefied and condensed, doth not belong to the *Essence* of a *Body*, but is only a new *Modification* of it, which supposeth a change of *Figure*, and the presence of another *Body* filling the *Pores* of it.

CHAP. XI.

Concerning the Heaviness and Lightness of Bodies.

I.
What Gravity
and
Levity is.

H *Heaviness* and *Lightness* are the *Qualities* of *Bodies* with respect to their aptness to move upwards and downwards, in the *Sphere* of their *Gravitation*. Where by the name of *Aptness*, we are not to understand any *Inclination* or *Active Principle*, but only such a disposition of *Parts* which is capable of receiving the force of *Heaviness* or *Lightness*. And by the *Sphere of Gravitation*, I understand the whole space comprehended between the *Center*, or that which is lookt upon to be the middle, and the uttermost bounds of the cause of depression. Which *Sphere* is not only to be fixed about the *Earth*, but also about the other *Planets*, which being much of the same nature with our *Earth*, it follows, that the union of their *Parts* proceeds from the same or a like cause to that which keeps the *Parts* of the *Earth* together.

II.
The opinion
of the Peri-
pateticks
rejected.

The *Peripateticks* hold *Heaviness* and *Lightness* to be innate *Qualities*, proceeding from the *Form* of *Bodies*, for their *Conservation*. Accordingly they say that *heavy things* tend downwards, from the foresaid *Appetite* they have to be preserved in the *Center*, and so be moved by a certain *Law of Nature*, whereby all things are disposed in their proper places, or by a *Motion* impressed by the *Author of Nature*. But this *Opinion* is grounded on a false *Hypothesis*. For, First it supposeth the *Earth* to be the *Center* of the *World*. Secondly, that *Bodies* that are put in *Motion* tend to *Rest*, tho' it be certain that nothing tends to its own destruction. Thirdly, that *Heavy Bodies* are preserved in the *Center*. Fourthly, that there is an *Appetite* or desire of this *Preservation* in *inanimate* things, when it is apparent that a desire is only competent to *living Creatures*.

III.
The opinion
of Gassen-
dus reject-
ed.

Others, amongst whom is *GASSENDUS*, hold that *heavy things* tend downwards by the *Magnetick Virtue* of the *Earth*, which draws them down to it. But this opinion also is built on a false

supposition, in that in the *First* place it takes for granted an attractive *Motion*. Secondly, in that it supposeth the *Loadstone* to draw *Iron* to it, by its out-flowing *Particles*, which is not so, as will appear hereafter when we come to speak of *Magnetick Operations*. Thirdly, the *Magnetick Virtue* is communicated by the *Poles*, and *Lines* parallel to the *Poles*; whence it must follow, that the greatest *Gravitation* would be under the *Poles*, or near them, less in the intermediate places, and least or none at all under the *Equator*. Fourthly, a common *Loadstone* has greater force, than the *Earth* itself, at least with us; whence it must follow, that it would be of greater strength also to the drawing of *Heavy Bodies* downwards; and then a piece of *Iron* cast upwards, would not in a right *Line* descend to the *Earth*, but towards the *Magnet*.

The Third opinion is that of *Des Cartes*, who holds that *Heavy Bodies* are driven downwards by the *Celestial Matter*. For the better understanding of which, we must in a few words explain his *Hypothesis* concerning the *Diurnal Motion* of the *Earth*. He supposeth therefore the *Earth* together with the *Atmosphere* to be pois'd in the midst of a little *Vortex*, which is whirl'd round from *West* to *East*; whence it necessarily follows by the *Rules of Motion*, that the *Earth* hanging in this *Fluid Body*, must be whirl'd about with the same motion, by the *Heavenly matter* running against its *Pores*: yet so as that the *Earth* in its *Motion* is not separated from the *Fluid Body* that compasseth it, but as it were swims in it. To illustrate this, let us suppose a *Wooden Bowl* in the midst of a *Vessel* with *Water*, if any one make the *Water* whirl round, that is, in the *Circumference* or near the sides of the *Vessel*, it is notorious that the *Bowl* will turn round likewise, by the *Particles of Water*, that dash against the outside of it; and in like manner, is the *Earth* with the *Atmosphere*, whirl'd about by the *Celestial circumfluent matter*, not by any motion of its own.

And forasmuch as the *Celestial matter* being very solid and agitated, hath more agitation in it, than is required to the whirling about of the *Earth*, and is hindred by the *Earth* from continuing its motion in *Right Lines*; what will follow hereupon? It is evident from the *Laws of Motion*, that its *Motion* cannot perish, and therefore will pursue its course, what way it can best; that is, it will have a *Power* of rebounding upwards. Now we know that nothing can move upwards except something move Downwards at the same time; and accordingly that will move downwards, which hath not so strong a force of *Agitation*, which is the case of all *Earthly Bodies*, except something else should intervene and hinder it.

Any one may Experience this by filling some round *Vessel* with small *lead*en *Bullets*, and amongst them, some pieces of *Wood*, or any other *Matter* lighter than *Lead*: If this *Vessel* be whirl'd round swiftly about its *Center*, all the pieces of *Wood* which have less *Agitation* will be driven to the Middle by the *Lead*en *Bullets*, which with greater force recede from the *Center* of their *Motion*.

The same was lately experimentally demonstrated by a *Mathematician* at *Paris*, in a *Vessel* with *Water* agitated, into which if the *Powder of Sealing-wax* be cast, the little *Particles* thereof

IV.
Des Cartes
his opinion
concerning
the Heaviness
of Bodies
explained.

V.
The force
of the Celestial
matter drives
heavy
things
downwards.

VI.
An Exam-
ple taken
from a
vessel fill'd
with vari-
ous matter.

VII.
Heavy
things do
not tend

down-
wards of
themselves
but are
driven
down.

will be seen driven towards the sides of the *Vessel*, for that by reason of their roughness they are easily carried that way by the strong agitation of the *Water*. But when that agitation begins to cease, and the *Particles* of the *Water* are more softly moved, this *Dust* or *Powder* is driven to the midst. The *Cause* whereof is this, because as long as any *Agitation* is continued in the *Water*, its parts endeavour to recede from the *Center*, in which recess they force the particles of *VVax* towards the *Center*, and as it were appoint their place to them. Whence it appears, that *Bodies* are not of themselves carried, but are driven downwards by the *Matter* that surrounds them.

VIII.
A particu-
lar Explan-
ation of
the Heav-
iness of
Bodies.

Figure 11.

But to the end that the *Action* of the *subtil Matter* may be more distinctly perceived, let us imagine all that is included in the *Circle* ABCD to be a *Mass* consisting of the *Earth*, *Water* and *Air*, the *Center* whereof is E, where the little *Circle* F GHI represents the *Earth*. Then let us imagine this whole *Mass* to be divided into many *Pyramids*, which with their *Extremities* reach to the *Center*, one whereof let be AEB. Having supposed this, we shall find first, that tho' all the several *parts*, which make up so many *Pyramids*, strive to withdraw from the *Center* E, yet can they not recede all at once, because there is no empty space about that *Mass* which they constitute, whither they might retire, and the subtil *Matter* hinders them from moving out of their place. Moreover we shall find that not one of these *Pyramids*, by Example, AEB, can recede whole and entire, enlarging it self in its extremity AB, and driving away from it the adjoining matter, and making it to come closer to the *Center*: Because the *Pyramids*, which surround the *Pyramid* AEB, do with a like endeavour recede from the same *Center*, and for which they have no less force, than the *Pyramid* AEB. But if we suppose some *Terrrestrial Body*, as L. in the *Pyramid* AEB. without any in the Neighbouring *Pyramids*; we shall easily conceive, that it will have less force to recede from the *Center*, than the others, that are about it, by how much the *Body* L hath less force than the subtil *Matter*, whose place it takes up. Whence we must conclude that the *Matter* of some of the *Pyramids* will recede from the *Center*, and drive the *Body* L nearer to it, after the same manner, as they who hold all *Bodies* to be Heavy, suppose the *Water* to lift up a piece of *Cork*, and force it to the *Surface* of it.

IX.
Wherein
the Heav-
iness of
Earthly
Bodies doth
consist.

The *Heaviness* therefore of *Earthly Bodies* consists in this, that the *Globuli* of the *Celestial Matter*, being whirled about in their *Vortices*, endeavour continually to recede from their *Centers*, about which they are turn'd; but forasmuch as they cannot exert this their strife and Propension, except in their mounting upwards, they thrust down other *Bodies* into whose place they may succeed: Wherefore they must needs at the same time depress the *Particles* of *Earthly Bodies* that are in the *Air*, as well because of their *Resistance*, as because of the want of *Celestial matter* in their *Pores*; both which hinder the *Earthly Particles* from having so great a Propension of receding from the *Center* of the *Earth*, as the *Heavenly matter* that every way surrounds them, hath. Wherefore the *Lightness* of the *Celestial Matter* is nothing else but the force or strife it hath to recede from the

Earth; as the *Heaviness* of the parts of the *Earth* consists in their being such, that this highly agitated *Matter* exerts its power upon them in thrusting of them downwards.

When it is said, that the *Heaviness* of *Bodies* is caused by the *Heavenly matter*, we do not only understand the *Globuli* of the *Second Element*, but also the *Matter* of the *First* mixed with it: For this being extremely agitated, exceeds the *Matter* of the *second Element* in the force it has to drive *Bodies* downwards. Neither are the *Particles* of the *Air* to be rejected from having any share in this performance, seeing that they accompany them in their *Course*, and being joyn'd with the *Globuli* of the *second Element*, exert their force, and do not a little conduce to the driving down of *Bodies*.

We may therefore alledge a double *Cause* of the *Descent* of *Heavy Bodies*; the one *Primary*, viz. the *Heavenly Matter*, by its strife upward, not from any innate Appetite, but to continue its *Motions* according to the *Laws* of Nature. The other *Secondary*, viz. any *Earthly Body* carried upwards, whether it be obsequent to the *Motion* of the *Heavenly Matter*, as *Air*, *Vapours*, *Exhalations*, and any other lesser *Particles*; or whether it be driven upwards by any other *Cause*: So *Smoke* agitated by the *Fire*, hath a Power of depressing the *Air*: Thus when any one casts a *Stone* upwards, he at the same time thrusts down as much *Air* in its place; which *Air* because of the *Heavenly Matter* intermix'd with its *Particles*, and its Agitation thereby caused, as likewise its *Elastic force*, will first resist the *Motion* of the *Stone*, next hinder its *Ascent*, and at last depress or thrust it downwards.

You will object, if the *Heaviness* of *Bodies* depend on both these *Causes*, it will follow that all *Bodies* would be of the same *Weight* or *Heaviness*, since both the *Heavenly Matter*, and the small *Bodies* carried upwards, do press them after the same manner.

I answer, that the Nature of *Heaviness* and *Lightness* in *Bodies*, consists herein, that as much *Heavenly Matter* as there is in any *Body*, so much cause of *Lightness* they have, which being subtracted, all the rest will come under the notion of *Gravity* or *Heaviness*. As for Example, *Water* is heavier than the *Air*, because if you subtract the *Aethereal* interspersed *Matter* from them both, there remains more *Earthly Matter* in the *Water*, than in the *Air*. So that this may be laid down as a General Rule, That the more *Heavenly Matter* there is in any *Body*, by so much the *Lighter* it is, that is, the more apt it is to be carried upwards; and the less there is of it, the *Heavier* that *Body* is, that is, the apter to be thrust downward.

Thus *Solid Bodies* are more *Heavy* than *soft*, because they have more *Matter* of their own, and therefore are called *close Bodies*, having less *Pores*, which can only admit the *Subtil Matter*, or the *Globuli* of the *second Element*, such as are *Gold*, *Silver*, *Quicksilver* and *Steel*. But *soft* or less *Solid Bodies*, contain more *Heavenly Matter*; and have greater *Pores*, and are therefore *Looser Bodies*, such as *Wood*, &c. Wherefore tho' all the *Heavenly Matter*, with all its force strives to recede from the *Center*; yet the more close and compact *Bodies* have a greater Power to resist, and do more difficulty recede from the *Center* of their

X.
By the
name of
Heavenly
matter we
are also to
understand
the First
Element.

XI.
The Cause
of the Des-
cent of
Heavy
Bodies is
Twofold.

XII.
Whence the
various
Heaviness
and Light-
ness of Bo-
dies doth
arise,

XIII
Solid Bodies
are more
Heavy
than soft
Bodies.

Motion:

Motion; whereas *Bodies* of a more loose Texture, have more of the *Heavenly Matter* than of their own, and a greater Propension of receding, and therefore do less resist the *Agitation* of the *Heavenly Globuli*, or little round *Bodies*.

This is the reason why the *Water* is placed on or above the *Earth*, and the *Air* above the *Water*; because the parts of the *Earth* being more solid than those of the *Water*, and the parts of the *Water*, than those of the *Air*, they are more strongly driven down to the *Earth*, by the *Aethereal Matter*; much after the same manner, as *Corn*, that is mixt with *Chaff*, is by the *Agitation* of a Fan cast off further, leaving the *Chaff* behind it.

It may be objected against this, that the *Globuli* of the second *Element*, do strike with a greater force against *Bodies*, before they begin to descend, than in their falling down; and therefore they ought to thrust them down more swiftly at the Beginning of their *Motion*, than towards the end of it; which notwithstanding is contrary to experience; for a *Stone* moves swifter towards the end of its *Motion*, than at the Beginning; and therefore the Descent of *Earthly Bodies* is not to be ascribed to the *Subtil matter*.

I answer, that the reason of the Difference of the *Stones Motion* is this, because the *Stone* in its Descent, retains the Force of the foregoing *Motion*, and besides receives an increase from the Impulse of the *Subtil Matter* that follows it; for the *Subtil Matter* is swifter than it. Now the cause why *Descending Bodies* are less forceably driven down by the *Subtil Matter*, towards the *End*, than at the Beginning of their *Motion*, is this, because there is not so great a difference of swiftness between their *Motion*, and that of the *Subtil Matter*.

But you will say, seeing that the *Bodies* that are surrounded with *Fluid Matter*, are equally prest upon on all sides, they are not like to move at all, but will remain hanging in the *Air*. I answer, that this indeed would follow, in case the *Fluid Body* be simply consider'd as *Fluid*: But since the case is otherwise here, and that the whole *Fluid Matter*, because of the Resistance of the *Earth*, strives to get free from its Neighbourhood, this is sufficient to determine the *Motion* of *Gross Bodies* downwards, as being much more unfit for *Motion*, than the *Heavenly Matter*, and *Fluid Bodies*, in which they are carried, are.

How Appositely this opinion solves all the *Phænomena* of *Heaviness* will appear from the following particulars.

First, This force will exert it self every where throughout the *Earth*, because the *Celestial Matter* will find resistance every where, that is, it will be determined upwards as well towards the *Poles*, as about the *Aequator* and *Lines Parallel* to it.

Secondly, All things fall down perpendicularly to the *Horizon*; because the *Celestial Matter* hitting against the *Earthly Particles*, will rebound back with infinite variety, because of their different meeting, Figure and Situation of their Parts, that is on every side equally, at least to *Sense*; and consequently will make all those things *Fluid*, which are fit to follow its motion; and whatsoever is impuls'd by the *Fluid Mass*, will fall perpen-

dicularly, because it is with equal force prest on all sides.

Thirdly, The *Sphere* of Gravity becomes terminated, where this force of receding, because of the too great distance, is not strong enough.

Fourthly, Here we find the reason, why every *Planet* hath its *Sphere* of Gravity, because nothing else is required to this, but its swimming in the midst of *Fluid Matter*.

From all that hath been said it is obvious, that *Heaviness* is nothing else, but the strife or effort wherewith a *Body* is pusht towards the *Axis* of the *Earth* by other *Bodies*, which strive to recede from it. That *Absolute Heaviness* is that by which every *Body* is pusht downwards by a Column of the second *Element* equal to its own; and that *Respective Heaviness* is that which belongs to a *Body*, only with respect to other *Bodies*.

C H A P. XII.

Concerning Place.

HAVING examin'd the *Rarefaction* and *Condensation* of *Bodies*, and inquir'd into the Reason of their *Heaviness* and *Lightness*, it remains now to consider why *Bodies* are said to be in a place, and what order they keep amongst themselves. Now *Place* is nothing else, but a respect of the Situation of a *Body*, which it hath amongst other *Bodies*, to which it is either near or far from. So that when we say that a *Body* is in a place, we only intimate thereby that it hath such a *Magnitude*, *Figure* and *Situation* amongst other *Bodies*, with respect to its nearness to them or remoteness from them.

True it is, that the Common People distinguish *Place* from a *Body*, and suppose *Place* to be the *Space* that receives a *Body*, and contains it. For they persuade themselves that *Place* is a kind of *Space* which Exists before the entrance of the *Body*, and remains after it is withdrawn. But this conceit ariseth from a Popular error, by which they imagine that there were some extended empty *Spaces*, before that there were any *Bodies* in Nature, and which were afterwards to receive them. As some *Philosophers* now since the *Creation* of the *World* fancy that there is a kind of empty *Space* beyond the Bounds of the *World*, which they call *Imaginary Space*, because it hath only *Extension*, without containing any *Body* at all.

But these *Philosophers* speak very improperly, since whatsoever is extended in *Length Breadth* and *Depth*, and wherein *Parts* can be assigned, by the intervals whereof *Bodies* may be said to be near or far off from one another, cannot be said to be a thing *Imaginary*, but a true and real *Body*. For the Nature of a *Body* consists in *Extension*, and the Idea of *Extension* is the same with the Idea of a *Body*. Seeing therefore the *Imaginary Space*, as they call it, hath *Length*, *Breadth* and *Depth*, it must needs be a *Body*. Whence it is apparent how improperly they speak, who tell us that *Bodily things* are in a *Space*; for since every *Space*, because of its *Extension*, is distinguish'd from the *Dimensions* of the *Body*, that is in the *Space*, and that Penetration of *Dimensions* is impossible, should we suppose a *Space* to receive a *Body*, this would be a *Penetration* of *Dimensions*. Now *Bodies* are there-

XIX.
Heaviness
is either
absolute or
Respective.

I.
What
Place is?

II.
What
Place is ac-
cording to
the opinion
of the Com-
mon People?

III.
Space is the
same with
a Body.

XIV.
Whence
proceeds the
variety of
Heaviness.

XV.
How it
comes to
pass that
a Stone to-
wards the
end of its
motion
comes down
faster than
at the Be-
ginning.

XVI.
Answer.

XVII.
How Bodies
can move
in the Air
seeing they
are prest on
all sides by
the Fluid
Matter.

XVIII.
This opinion
doth most
appositely
explain all
the Phæno-
mena of
Gravity.

IV.
In what
Sense a Bo-
dy is said to
be in a
place.

fore said to be *impenetrable*, because they have their peculiar *Dimensions* which exclude any other, and do not suffer them to be contain'd in the same place; and since a Space is measur'd with the same *Dimension* as a *Body*, therefore a *Body* cannot be said to be in a *Space*.

But you'll say, how then is a *Body* said to be in a *Place*, if a *Place* be extended as well as a *Body*, and that one of them exclude the other? I answer that a *Body* is said to be in a *Place* by the *Situation*, *Magnitude* and *Figure* it hath amongst other *Bodies*; so that we must not conceive anything as extended, but only the *Body* that is in the *Place*, and all the *Space* or *Expansion* that is conceiv'd to be there, must be attributed to the *Body* only. For to speak properly, *Place* or *Space* is nothing else, than something that is extended in *Length Breadth and Depth*, which is the same with *Matter*; neither can it be distinct from it, but by our way of conceiving. Wherefore when a *Body* is said to take up a *little* or *great* place, the meaning of it is only this, that such a *Body* hath a greater or less *Extension* amongst the *Bodies* that surround it. This gave occasion to St. AUSTIN to say *Epist. 52. ad Dard. Take away Spaces from Bodies, and they will be no where, and being no where they will not be at all.*

V.
Space is
not Really
distinct
from a
Body.

Wherefore there is no Real Difference between a *Space* and a *Body*, but only according to our way of *Thinking*, viz. because we consider the *Extension* of *Space* as *Common* and *General*, but the *Extension* of a *Body* in a *Space*, as *Individual* and *Singular*. As for Example, when a *Stone* is taken up out of its place, we suppose its *extension* to be removed also, because we look upon it as *singular* and *inseparable* from it; but yet we conceive that the *Extension* of the place in which the *Stone* was, still continues, and is the same, tho' the *Stones* *Place* be now taken up by another *Body*, viz. *Wood, Air, &c.* Because this *Extension* is consider'd in *General*, and suppos'd to be one and the same, whether of the *Stone, Wood, Air*, or any other *Body*, provided it be of the same *Bigness*, and have the same *Situation* amongst those *Bodies* that determine and bound that *Space*. Wherefore it is evident that the *Inward Place*, which is taken up by any *Body*, doth not differ from the *Body* it self, no more than the nature of the *Genus* or *Species* differ from the *Individual*. And tho' a *Body* may be said to change its *Place*, this is not to be understood of the *Inward*, but only of the *outward Place*, that is, of the *Superficies* of those *Bodies* that surround it, to the different parts whereof, it may be diversly apply'd.

VI.
Place is
twofold,
Inward
and *Outward*.

This will be more evident by distinguishing *Place* into *Inward* and *Outward*; *Inward Place* is nothing else but the *Matter* it self extended in *Length Breadth and Depth*, or the *Body* it self: *Outward Place* is the *Superficies* of the *Body*, which immediately surrounds the thing *Placed*. And this *Place* is neither a *Body*, nor any thing of a *Body*, but only a *Mode* of it, or the limit wherein the *Body* is contained. For by the name of *Superficies*, no part of the *Ambient Body* is understood, but only the *Boundary* or limit, that intervenes between the *Ambient Body* and the *Body* surrounded, which is only a *Mode*. Or we understand thereby a *Superficies* in common, which is no more the part of one *Body* than of another, only is suppos'd al-

ways to be the same, because it retains the same *Magnitude* and *Figure*. For tho' every *Ambient Body* together with its *Superficies* be changed, yet is not the thing it surrounds therefore supposed to change its *Place*, provided it keep the same *Situation* amongst other *Bodies*, which are consider'd as *immoveable*. Thus we do not say that a *Tower* changeth its *Place*, when the *Ambient Air* leaves it, because we suppose that still other *Air* comes in the room of it, and accordingly the *Superficies* is neither a Part of the *Body* containing, nor of that contained, but only an intermediate term or limit, which indeed is nothing else but a *Mode*.

Moreover it is evident, that, if there were any such *Imaginary Spaces*, the *Bodies* contained in them could not be said to be in a *Place*, forasmuch as in them there is no *outward Place*, neither can any parts be assigned to them; and therefore a *Body* cannot be said to be *here* or *there* in them, notwithstanding that it really takes up a *Place*. But a *Body* being consider'd as something consisting of *Parts*, and consequently contiguous to other *Parts* of *Bodies*, according to this *Notion* there can be no *Body*, which hath not a determin'd *Place*, with respect to its *nearness* or *contiguity* to some other *Body*, by which its *External Place* is designed.

The difference therefore between *External Place* and *Space* is only this, that *Place* more expressly denotes the *Situation* of a *Body*, than its *Magnitude* or *Figure*; whereas *Space* refers rather to these two latter. For we often say that a *thing* comes into the place of another, tho' it be not exactly of the same *Bigness* or *Figure*; but at the same time deny it to take up the same *Space*: And so whenever the *Situation* is changed, we see the *Place* is changed, tho' the same *Bigness* and *Figure* do remain. And when we say that a *Thing* is in a *Place*, we mean nothing more than that it hath such a *Situation* amongst other *Bodies*; and when we say that it fills such a *Space*, we understand thereby its being of such a determinate *Figure* and *Magnitude*. All which will be further cleared by the following *Rules*.

When a *Place* is said to be equal to the thing placed, this is either understood of the *Inward Place*, and then it is the same, as to say, that a *Body* is of such *Dimensions*, or equal to it self; or else of the *Outward Place*, and then it imports, that the bounds of the *Ambient*, do exactly answer to the *Superficies* of the *Body* surrounded or contained, but not as if they had equal *Dimensions*: in like manner as the *Rule* is said to agree with the thing ruled, tho' it do not agree with it every way, as to its threefold *Dimension*.

Two *Bodies* cannot be in the same place at once, that is, they cannot at the same time have the same respect of distance to the same *Bodies*; for if so, they must penetrate each other, and there would be a *Multiplication* of *Extension*, without supposing any new *Parts*, which is contradictory to the *Notion* of a *Body*.

One *Body* cannot be in two *Places* at the same time, that is, it cannot be placed between these and other contiguous *Bodies* at the same time, because a *Plurality* of *Places* infers a *Plurality* of *Bodies*; for *Place* is only the *Mode* of a *Body*: Or thus: *Space* is not distinct from a *Body*, therefore the *Body* that is in diverse *Spaces*, is both another and the same thing at the same time.

Fourthly,

VII.
A *Body* in
the *Imagi-
nary Space*,
is neither
here nor
there.

VIII.
The Diffé-
rence be-
tween Ex-
ternal
Place, and
Space.

IX.
The First
Rule.

X.
Second
Rule.

XI.
Third
Rule.

XII.
The Fourth
Rule.

Fourthly, a *Body* is said to change its *Place* when it changeth its respect to other *Bodies*; and forasmuch as we can have regard to different *Bodies*, the same thing may be said to change its *Place*, and not to change it, under a different regard; tho' most properly a thing is said to change its *place*, with respect to those *Contiguous Bodies*, that are considered as immoveable.

XIII.
How the
Inward
Place is
disting-
uish'd
from the
Outward.

Whence it appears that the *Inward Place* of a *Body*, or the *Space* it takes up, consists in the *Body* it self, consider'd as bounded by other *Bodies*, which immediately touch it; and that the *Outward Place* consists in the first *Surface* of the *Bodies* that surround another *Body*.

CHAP. XIII.

The supposing of a *Vacuum* in Nature, implies a *Contradiction*.

I.
What a
Vacuum is
according
to the Sense
of the Com-
mon People.

IT cannot be denied but that the common way of *Speech* doth frequently differ from *Truth*, and that they are lyable to mistake, who mind words rather than their own *Notions*; as they seem to do, who by the word *Vacuum*, understand the absence of some *Body*, which ought to be in such a *Place*. As when they say, that a *Vessel* is *Empty*, which is not fill'd with *Water*, *Wine*, or the like; or a *Purse* is *empty*, in which there is no *Money*, and a *Space* empty in which there is no sensible *Body*.

II.
What a
Vacuum is
according
to the sense
of Philoso-
phers.

But learned *Men* allow nothing to be empty, but what is devoid of any *Body* whatsoever; and therefore they commonly define it a *Place void of Body*, yet fit to be filled. This *Vacuum* is twofold, *Disseminate* or *Coacervate*.

III.
What a
Disseminate
Vacuum is.

A *Disseminate* or interspers'd *Vacuum* they call small *Spaces*, which are suppos'd interspers'd between *Material Things*.

IV.*
What a
Coacervate
Vacuum is.

A *Coacervate Vacuum*, is a sensible *Space* void of *Body*, such as they suppose to be in a *Pipe of Glass* after the removal of the *Quicksilver* in the *Toricellian Experiment*.

V.
That nei-
ther the
one, or the
other of
these *Va-
cuums* can
be admit-
ted, appears
First
from the
Nature of
a *Body*.

That neither of these *Vacuities* can be found in the *Universe*, may be prov'd by many *Arguments*. First because every *Space* imports *Extension*, which is of the *Essence* of a *Body*; for it implies a *Contradiction* that *nothing* should have an *Extension*, and therefore there cannot be any *Space*, in which there is not a *Corporeal Substance*. For as we suppose a *Body* to be there, where we find *Extension*; so for the same Reason we must conclude, that a *Body* must be in a *Space*, because we clearly conceive *Dimensions* in it: So that it is not more impossible to conceive a *Mountain* with out a *Vally*, than to conceive *Space* without *Matter*.

VI.
Secondly
from the
Definition
of a *Va-
cuity*.

Secondly, a *Vacuum* is defined to be *A place devoid of Body*: Now this also implies a *contradiction*, supposing the notion we have already given of *place* to be clear and distinct; for where there is no *Body*, neither can there be any *Mode* of a *Body*; yea, the very empty *Space* it self, will be no less in a *Place*, than any *Body* whatsoever, as is evident to him that considers it well: And what can be more unworthy for a *Philosopher*, than to accommodate this *Idea* to a *Non-Entity*, which altogether agrees to a *Real Being*?

VII.
What
would fol-
low, if
whatsoever
is in a
Space should
be taken
out of it by
God.

You'll say that *God* can take away all the *Substance*, that is contain'd between the *Walls* of a *Chamber*, and keep any other *Body* from entering it; upon which supposition a *Vacuum* must follow.

I answer in the *First Place*, that this or the other *Body* may be taken out of a *Chamber* or any *Vessel*; but it is impossible that they should be without any *Body* at all. For where there is no *Body*, there is no *Extension*, where there is no *Extension*, there is no *hollowness*, capacity or interval, and without these there can be no *Vessel* or *Chamber*.

VIII.
First An-
swer.

Secondly I say, that supposing all intermediate *Bodies* to be taken away, the *Chamber Walls* would touch one another, because nothing would be between them; for we cannot conceive one thing to be distant from another, without some *Middle* thing to separate them; because *distance* is a *Mode* of *Extension*, and therefore follows a *Bodily Substance*, without which it can neither be, nor be conceived.

IX.
Second An-
swer.

But you will say, that the *Body* which is conceiv'd to be in the *Chamber* or *Vessel*, is something different from the sides that surround it, and therefore the one may be separated from the other by the *Divine Power*, forasmuch as we clearly and distinctly understand the one, not to be the other.

X.
To conceive
a *Space*
without
Extension,
implies a
*Contradi-
ction*.

I dare not say that any thing is impossible to *God*, or that he cannot make a *Mountain* without a *Valley*: But this only I assert, that *God* hath made my *Mind* such, that I cannot conceive how a *Mountain* should subsist without a *Valley*; or how *Five* and *One* should not make *Six*. And the same may be applied to that *Space* which is imagin'd to be between the *Sides* of a *Chamber* or *Vessel*, because the same cannot be conceived without *extension*. And since *nothing* can have no *Properties*, that *Space* cannot be said to be a *Vacuum* that is void of all *Matter*. Or if that should be, the *sides* of the *Chamber* or *Vessel*, must be suppos'd to touch each other. For if *God* should annihilate all the *Air* that is in a *Chamber*, there would be no *Space* left between the *Walls*; for if any *Space* be left, there must be *Magnitude* also; and if *Magnitude*, then *Quantity*; and if *Quantity*, *Matter*, and consequently a *Body*, because *Space*, *Magnitude*, *Quantity*, *Matter* and a *Body* are one and the same thing.

XI.
If *Bodies*
be taken
away, all
distance is
taken away
likewise.

For what can be imagin'd more absurd than to assert that the *distance* of *Bodies* is owing to an *Imaginary Space*, or *nothing*, seeing that when the intermediate *Body* is taken away, all *distance* must of necessity be taken away likewise? Who will say that *nothing* can be measur'd, when it is evident, that not only *Extension*, but any other *Propriety* whatsoever, must be remov'd from *Nothing*? For if I may say that a *Space* (which is nothing) is of such a length, I see no reason why I may not as well ascribe other *Properties* to it, such as *Hardness*, *Softness*, &c. It remains therefore that *Nothing* cannot make a *Distance* between *Bodies*. For suppose we a *Square Vessel* ABCD, and the *Hollow* of it to be empty, I say that the same cannot be measur'd: For tho' if it be enquir'd by what thing the sides AB, DC are distinct from one another, it may be readily answer'd by the *Straight Lines* AD, BC. Yet I cannot return the same answer to him that enquires the *distance* between the opposite *Angles* DB: for if I should say they are kept at a *distance* by the *Straight Line* DB, how can this be true, seeing nothing at all is in the *Vessel*, and therefore no *Length* or *Measure* can be apprehended in it?

Figure 3:

This Conclusion may be confirmed from the necessity there is of a *Connexion* of all the *Bodies* that do constitute the *Universe*, and that they be so joyned

XII.
There is a
necessity for
the *Con-
nexion* of
Bodies.

XIII.
Supposing a
Vacuity,
two Round
Bodies
would to-
tally touch
one ano-
ther.

XIV.
An Objection,
that
Distance is
nothing
else, but a
negation of
contact.

XV.
The Ob-
jection an-
swer'd, and
distance
prov'd to be
Extension.

XVI.
Nature
doth not
abhor a
Vacuum.

XVII.
Water con-
densed in a
close stopp'd
Vessel, doth
not leave a
vacuity.

joyned together as not to be separable from each other. Which yet is not so to be understood, as as if there were such a Connexion, between this Chamber suppose, and the particular Air that is in it, that they cannot be separated from each other; for we see that this Air is driven out by the Wind, and that other comes into its place; but only thus much, that there is a necessary Connexion between this Chamber, and Quantity in General, forasmuch as there can be no Distance or Interval, but must be fill'd with some Body or other.

The same may be farther prov'd from the Absurdity which would otherwise follow; because supposing a Vacuum, Round Bodies would touch one another after the same manner as Flat Bodies do, that is, totally. For those Bodies are said totally to touch each other, between which there is no intervening Medium; but betwixt two Round Bodies in a Vacuity there can be no Medium assign'd; therefore they touch with their entire Surfaces. It is not sufficient for the solving of this, to say, that a Possible Substance mediates between them, because a Possible Substance cannot be an Actual Medium dividing and separating Bodies: For otherwise nothing in the World could be said to be united; since between the Parts of Bodies that are united there is some Possible Medium that may divide them.

If you say that Distance is no Real Thing, because two Bodies may be conceiv'd to be distant, only by the Negation of their contact; and that it is not necessary for any thing to intervene between Bodies to make them distant from each other.

I answer, seeing Distance is a Relation, which must be between more than one, it belongs to Opposition or Distinction, the Essence whereof consists herein, that one thing is not the other. But forasmuch as there is no Real Distinction, which hath not its Foundation, because nothing can have no affections, therefore the Foundation must consist in something that is different from the things between which there is a Distance, which since it cannot be Spiritual (for then it would be void of Extension) it must be Material or Corporeal. For it would be a very improper Answer to the Question, why London is at a distance from Paris, to say, Because they do not touch one another; for this would be the same thing as to say, that London and Paris are at a distance, because they are not near one another, which is to explain an unknown thing, by another thing equally unknown. We conclude therefore, that Distance, besides the Negation of Contact doth necessarily include Extension, by means whereof remote Bodies are said to be distant from one another.

Hence it appears how falsely the Schools assert, that the motion towards mutual Contact, is prevalent above all others, as being ordained for the Conservation of the Universe, by the avoiding of a Vacuum in Nature: For how can Nature be said to avoid a Vacuum, seeing that an Empty Space implies a contradiction? For those things are us'd to be forbid by the Laws, which may be done, and not such whose being implies a contradiction.

All other Arguments made against this opinion are of no force at all against us, who assert the Extension of Space, not to differ from the Extension of a Body, forasmuch as it includes Length, Breadth and Depth. What they object of a Vessel fill'd with

hot Water, which tho' it be close stopp'd, yet the Water that is in it, is reduc'd to a less Space, and consequently must leave a Vacuum, is of no Moment at all, because the Space which they imagine to be void, is fill'd with the subtil Matter penetrating the Pores of the Vessel; for it is a meer vulgar Error, to believe those things to be Empty, which we do not see to be fill'd with Bodies.

It is evident from what hath been said, that a Vessel doth not contain more Matter when it is fill'd with Gold, than when it is fill'd with Air, forasmuch as there is as much extension in the Air as in the Gold. A Vessel indeed may contain more Gold, than it can of Pumice Stone, because in this latter there are many Pores which are fill'd by the Air, and not with its own Substance.

XVIII.
A Body is
no less fill'd
with one
Body than
with ano-
ther.

CHAP. XIV.

Of the Vulgar and Philosophical Definition of Motion.

BY the name of Motion we only understand that which is Local, as being the only Motion that is found in Nature, and to which all the rest are to be refer'd. For tho' ARISTOTLE Lib. 8. Physic. cap. 7. reckons up three kinds of Motion, viz. Motion in Magnitude, in Affection, and in Place; yet he asserts that the latter of these must needs be the first of all Motions, and concludes, that Generation and Corruption, Accretion and Diminution, and last of all, Alteration, cannot be without Local Motion. For what else is the Motion of Generation and Corruption, but Local Motion, whereby the sensible and insensible parts, are fitly, or unfitly joyned together, according to the Essential Constitution of Bodies? So likewise in Accretion and Diminution there is a Local Motion, whereby several parts are united to the Body growing; or whereby those that have been joyned with it, are now separated from it. And as to Alteration, we find for Example, that Calcification or Heating is perform'd by Local Motion, it being nothing else but the swift agitation of the parts of some Body; as in Refrigeration or cooling, the said parts are more slowly moved, or have no Motion at all. Tho' indeed if we would speak strictly, all the other Species of Motion that are commonly reckon'd up, are rather changes made by Motion, than Motions.

Wherefore seeing that all these kinds of Motion, are only certain differences of Local Motion, denominated from their various effects of Generating, Corrupting, Encreasing, Diminishing and Altering, we should multiply Entities in vain by going about to establish any other sorts of Motion, besides this.

But that we may the more clearly discover the nature of Motion, we will first enquire what is understood by this Word, according to the vulgar acceptance of it, and then come to explain the true and Philosophical Notion of it.

The Common People by Motion, understand the Action whereby some Body is remov'd from one place to another. This is that which they do mean by Local Motion. And therefore they suppose that a Body may at the same time be moved, and not be moved, as a Master of a Ship, who is said to be moved, if the Shoar be consider'd as immovable; and not to be moved, with relation to the Stern of the Ship.

I.
Local motion
only is to
be admitted
of in Philo-
sophy.

II.
All other
Motions are
but the
Differences
of Local
Motion.

III.
Motion ex-
amin'd ac-
cording to
the sense of
the Com-
mon People.

IV.
What the
Common
People un-
derstand by
Motion.

Ship where he sits. Secondly, by this action the Common People imagine, that a greater force is required to produce Motion than Rest. Which Judgment they make, because they find that the Command of their Will is required to the moving of their own Bodies, whereas they Rest by their own Weight, without standing in need of any other thing to stop them. But they may be easily convinc'd of their error by putting them in Mind, that very often there is as much action required to stop the Motion of Bodies, as there is to move them! For there needs as much force to stop a Stone that is tumbling down from a Mountain, as to tumble down a Stone, that lies still on the top of it.

V. Five things to be consider'd in Motion. There are five things to be consider'd in every Motion; the mover, the moved, the Term from which, and the Term to which, and Succession. The mover is that which doth move; the moved, is the Body that is moved by the Action of the mover; the Term from which, is the Neighbourhood of those Bodies which it quits; and the Term to which, is the Neighbourhood of those Bodies to which the Body comes; and Succession is that progress whereby the thing moved is continually in a different manner apply'd to the various Parts of Ambient Bodies.

VI. Wherein Motion properly doth consist. Now to the end that this Progress or Succession may be the better understood, we are to observe, that Motion may be consider'd three manner of ways: First, as it proceeds from the mover, as by example, from a Man who throws a Stone, and so in the mover it is call'd an Action. Secondly, as it is receiv'd in the thing moved, at the first moment of its impulse, whilst it is yet joyned to the mover, Ex. Gr. in the Stone, which a Man casts, and so it is a Passion. Thirdly, forasmuch as it is in the Body moved, separated from the mover, as in a Stone, when it is carried through the Air, and so it is a certain Mode or state opposit to Rest; and in this last Sense Motion is here taken: And accordingly Motion is defin'd to be, the Translation of a Definite Body from the Neighbourhood of Bodies that immediately touch it, to the Neighbourhood of other Bodies. Or it is the successive application of one Body, to the Parts of Bodies immediately touching it.

VII. Why Motion is called Translation. It is call'd a Translation in the first place to shew that Motion is not a thing subsisting, but only a Mode of Substance: For a Body is otherwise when it is moved than when it rests. Secondly, to distinguish it from the Action that translates it, or the Cause of its Motion: For that Rule of Logick is sufficiently known, that the cause cannot be the Genus: For we do not say that a sound is the motion of the Air, but a Quality arising from the Motion of the Air. And in like manner we must not say that Motion is an Action, but a Translation caused by some Action or force, which will more clearly appear, when we shall shew hereafter, that the Moving force is not a Mode of the Matter, but the Action of God.

VIII. And from the Neighbourhood of Bodies that touch it. It is said to be the Translation of one Body out of the Neighbourhood of Bodies immediately touching it, &c. not from one place to another, because by the word Place nothing of certainty is signified, forasmuch as with respect to diverse things, the same thing may be said to change its Place, and not to change it. So he that sits in a Ship, changes his Place with regard to the Shoar, which he leaves,

and does not change it regard being had to the parts of the Ship. Now by defining Motion to be a Translation from the Neighbourhood of contiguous Bodies, we denote that the Body is moved by its own proper Motion: So that tho' many common Motions, may be at the same time attributed to the same Body, yet one of these only is its Proper Motion, viz. that whereby it is separated by Bodies contiguous to it. As he that sits in a Ship, tho' he participate of the various Agitation of the Ship, yet is he not moved with any proper Motion of his own, because he abides fix't and unmov'd as to the contiguous Bodies that are about him.

IX. What is meant by one Body in the Definition. By one Body is understood all that which is transferred; tho' it may consist of many parts, which have other Motions. Because these Motions are not really distinct; it being a difficult thing to understand so many Motions together: As for Example, when the Body of an Animal is moved, his Tongue, Hands, Blood, and Spirits are moved also; all which Parts have their particular Motions, besides the common Motion of the whole Body, which they partake of.

X. How Bodies are moved, since there is no Vacuum into which they may be received. But the Difficulty is since there is no Vacuum in Nature, and that all the Bodies of the Universe, have proportionate places which they fill up, how can Bodies be moved when there is no empty space to admit them?

XI. Answer. I answer that local motion may very well be performed notwithstanding the absolute Plenitude of the Universe, not by means of any Compression and Dilatation of the Fire (as the Peripateticks tell us) but by a circular yielding of Bodies; so that when a Body is moved, it thrusts the next Body in its way out of the Space, which it enters into, and that again thrusts out another, and so to the last; which enters upon the place which the first Body has left, at the same instance that it leaves it. This we see in a round Pipe fill'd with Bullets, that the first of them cannot be moved, except the last by the impulse of the intermediate ones do succeed into its Place. Thus our Philosophy rejects all similar, Magnetical and Electrical Attraction, and every motion which is not performed by the impulse of Bodies, according to the Rules hereafter to be mentioned.

XII. How it comes to pass that liquor doth not run out of a Tasting Pipe. So that whenever this Circular Motion of Bodies is hindered, there can be no Motion at all; as may be seen in a Tasting Pipe used by Wine Coopers, represented by ABC, the upper Orifice A, being shut, and the inferior C, open. For tho' the liquor that is contain'd in it be much heavier than the Air, that is without; yet because the Air that is prest by the liquor ready to run out of the under Orifice C, cannot recede, because the upper Orifice A, is stoppt from receiving the Air that should succeed instead of the liquor running out of C, therefore the liquor continues in the Pipe as finding no place to receive it, because the circular Motion of Bodies is hindered, by the stopping of the upper Orifice of the said Pipe.

XIII. A Body is more swiftly moved through a narrow Passage. Thus may we see that the Motion of Bodies may very well be explained without penetration of Dimensions. And if it chance to happen, that the Circle through which the Body is to pass be unequal, that is narrower in one part than another, it must necessarily follow that the Body must be more swiftly moved where its passage is narrow, and so compensate the straitness of the place, by the celerity

IX. What is meant by one Body in the Definition.

X. How Bodies are moved, since there is no Vacuum into which they may be received.

XI. Answer.

XII. How it comes to pass that liquor doth not run out of a Tasting Pipe.

Figure 4.

XIII. A Body is more swiftly moved through a narrow Passage.

ity of its *Motion*. For it is one of the *Laws* of *motion*, that when any liquor passeth from a large place to a straiter, the swiftness of its motion encreaseth proportionably to the decrease of the wide-ness of its passage. This may be shewed by many examples : Thus *Winds* are more vehement in a narrow passage, than in a wide *Street* ; a *Bellows*, tho' but leisurely compress'd, sends out the *Air* through the *Nuzzle* with great swiftness and force ; and *Waters* otherwise gliding gently, when they pass through *Sluces* run violently ; and this because it is necessary that the whole *Circle* of *Bodies* should move all at once.

XIV.
Plato's
way of ex-
plaining
how all mo-
tion is made
by a Circle.

This opinion is thus explain'd by *PLATO* in his *Timaus* : Forasmuch, saith he, as there is no *Vacuum* any where, into which any thing that is moved can enter, and yet our breath continually goes out from us, it is apparent to every one that it goes not into an empty space, but drives the *Air* next to it, out of its place, which again drives away the next to it; and according to this necessity whatsoever is driven into the place, whence the breath came forth, doth follow it. And all this is perform'd at once by a certain Revolution, since there is no vacancy any where. Wherefore as soon as the *Breast* and *Lungs* have let out the *Breath*, they are immediately fill'd again with the *Air* that surrounds and penetrates the *Pores* of the *Body*. And again the *Air* flying out of the *Body*, and the let out breath, forceth us to draw in our breath again, by the *Passages* of our *Mouth* and *Nostrils*.

XV.
Motion is
not contra-
ry to Moti-
on, but to
Rest.

One *Motion* is not contrary to another *Motion*, because when two *Bodies* of the same *Bigness* and *swiftness* meet, they do not lose their *Motion*, but are only reflected, and then so continue their *Motions* again. But *Rest* alone is contrary to *Motion* : And tho' a *slow Motion* may be said to be opposit to a *swift*, that is only because a *slow Motion* partakes of *Rest*.

XVI.
What Rest
is.

For *Rest* is a Continuance of a thing in the same place, or an adhesion to the same Contiguous *Bodies*. This is an Affection proper to matter, which consider'd simply in it self; without any force from without impress'd upon it, continues unmov'd, that is, hath its parts continuous to it self. Now this *Rest* or *Quiet* is something Positive as well as *Motion* : For *Rest*, according to its Magnitude, resists motion more or less, alters the determination of motion, and keeps the parts of continuous and hard *Bodies* close together, which could not be done by that which is merely Private. And indeed forasmuch as *Rest* is something stable and permanent, if compared with motion, which is flowing and passing, we cannot deny it Reality.

XVII.
Rest is op-
posit to Mo-
tion.

Rest therefore is oppos'd to motion, not Privatively, as *Habit* and *Privation* ; but Positively, as two contraries, whereof the one is contrary to the other ; for *Rest* is adverse to motion by resisting it, and that either by diminishing it, or reflecting it.

XVIII.
Motion and
Rest are on-
ly Modes of
things.

Motion is not a *Real Quality*, as the *Peripateticks* suppose, but only a *Mode* which is not distinct from the *Body*. For we cannot conceive it to be any thing else, but the change whereby a *Body* is translated, or withdraws from some other *Bodies* that immediately touch it. As when standing on the *Bank* of a *River*, we see a *Fish* for some time continuing over against the same place,

without being carried away by the course of the *Water*, which on all sides surrounds it, we must conclude it to be really moved, because the whole outside of the *Fish*, is successively apply'd to diverse parts of the *Water* that do immediately touch it ; and because we find all that in it which happens to another *Fish* that swims in a *Pond* ; and moreover the effort he useth makes him successively to correspond to different parts of the *Water*. And on the contrary when we see a *Stick* driving in the *Water*, so as to be always apply'd to the same parts of the *Water*, we must say that it doth not move, but lye still, forasmuch as the said *Stick* is without any *Action* of its own, and doth not correspond successively to divers Parts of the *Water*, because a *Stick* in this case, and the *Water*, make up but one thing, which is really moved.

As we cannot conceive an Application to be made to different Parts, without conceiving a *Body* that applies it self to them ; therefore we are to judge, that *Motion* is not an Absolute Entity, as hath been said before, but only the Modification of a *Body* that is moved ; and so *Rest* likewise the Mode of a *Body* resting. Whence it appears, that *Motion* and *Quiet* superadd nothing more to a *Body* moved or Resting, than *Figure* superadds to a *Body* figured. And seeing that a *Body* may either be moved, or not moved, we must conclude, that *Motion* and *Rest* are Accidental to *Matter*.

XIX.
Motion and
Rest are
the Modifi-
cations of
a Body.

We may also infer from what hath been said, that there is no violent Motion in Nature, since it is as connatural to *Bodies* to push forwards one another, as to rest and lye still. For *Matter* consider'd in it self, being idle and unactive, and receiving its motion from an External Principle, it follows that *Motion* equally agrees to all *Bodies*. Neither can the *Motion* of a *Stone* cast upwards, be said to be violent, any more than the *Motion* of a *Ball* when it falls down perpendicularly to the *Earth* : For as the *Motion* of a *Stone* cast up into the *Air*, proceeds from the force of him that casts it up ; so the descent of a *Ball* proceeds from the subtil matter which carrieth the *Earth* and compresseth all its parts towards the Center. For the word *Violent* hath reference only to our Will, which is said to be forced when any thing happens to it, which it resists and strives against.

XX.
There is no
violent Mo-
tion in Na-
ture.

CHAP. XV.

Of the Principle of Local Motion.

Forasmuch as *Matter* hath no power to attribute any motion to it self, or to remove another *Body* out of its place (as shall be said in the following Chapter) we are to enquire here what is the Cause of motion in the Universe. In which enquiry, that we may follow the order we see in the World, we shall pitch upon two Principles of motion ; the one General, on which all motions in the world do depend ; and the other Particular or secondary, to which all singular motions are attributed.

I.
There are
two Prin-
ciples of
Motion.

The First and Universal Cause is that which first put matter into Motion, and is no other but God alone, who bestowed Motion upon the matter he had created, and preserves the same by the same Action by which he produc'd it at first ; and because it is agreeable to Right Reason, and the Idea we have of

II.
God is the
first Cause
of Motion.

of God, that he should conserve his *Creatures* in the most simple way; it seems more than probable that God continues the same *Agitation* in the *Universe*, which he impress'd on it at first, yet so as that he can always whensoever it pleaseth him change these *Laws*, which he hath established.

III.
The Second Cause is the meeting of other Bodies.

The *Second* or Particular Cause is the meeting of *Bodies*, by which means it happens, that this *Divine Action*, which preserves *Motion*, exerts it self sometimes in these, sometimes in other *Bodies*: Whence the difficulty which ariseth from the Communication of *Motion* may be easily solved; for tho' *Motion*, as being only the *Mode* of a *Body*, cannot remove from one *Subject* to another, which *Regius* unwarily asserts; yet the agitating force, being no *Mode* of a *Body*, may by removing shew it self sometimes in this, sometimes in the other *Body*.

IV.
The Communication of motion is performed according to the Laws at first set by God.

Whensoever therefore *DES CARTES* speaks of the Communication of *Motion*, he is to be understood of that *Power*, which preserves *Natural Things* in the same condition wherein they were constituted at first, and all effects order'd according to the *Laws* appointed for them, and suiting to their *Natures*.

V.
Three Laws of Nature.

There are three *Laws* of *Nature*, which are founded in that most simple *Concourse*, whereby God preserves all *Bodies*, which are very conducive to understand the *Nature* of *Motion*.

VI.
The First Law of Nature.

The *First* is this; Every *Natural thing*, if it be simple and undivided, always inclines to continue in the same state wherein it is: So that no change can happen to it, but from some outward *Principles*. Thus a *Round Body*, always keeps its *Round Figure*, neither is the same destroy'd, but by some supervening foreign *Agent*. And supposing the same *Body* to be moved, it will still proceed further, except it meet with some impediment that puts a stop to its *Motion*. And according to this *Rule*, we say, that a *Body* once put into *Motion*, for example, a *Ball* struck by a *Racket*, doth not stop at the *Wall* from whence it is reflected; for should we suppose any interruption in its *Motion*, we should be at a loss to find the cause that excites a new *Motion* in it again. Wherefore we must conclude that that which is moved, is always moved, and that which rests, rests always. And for this cause it is that a *Stone* continues its *Motion*, after it is let go out of the hand of him that throws it.

VII.
The Reason of the foregoing Rule.

This *Rule* may easily be gather'd from what we shall say in the following *Chapter*: For seeing that a *Body* cannot move it self, it follows, that that which rests, must persevere so, except by some outward force it be driven out of its place. And in like manner, when a *Body* is once put into *Motion*, no reason can be assign'd why it should not continually proceed therein, with the same *swiftness*, as long as it meets with nothing that stops its career. For since nothing can be done without a *Cause*, the state of a *Body* cannot be changed without the *Action* of a *Cause*. Hence it is that a *Leaden Bullet* being let fall from the top of a *Mast*, notwithstanding the swift course of the *Ship*, yet falls down straight to the bottom; for the *Motion* of the *Bullet* being a Compound of *progressive* and *descentory Motion*, and both of them continuing in the same state, it is evident that the *Bullet* can fall no otherwise than it doth.

Wherefore we shall meet with no change in *Bodies*, as to *Motion* or *Rest*, *Swiftness* or *Slowness*, *Figure*, *Situation*, *Magnitude*, &c. which do not proceed from without, the searching out of which *Causes* is the particular task of *Natural Philosophy*. *Water* indeed doth by degrees lose its *Heat*, but then it is no simple, and undivided *Body*; for it derives its agitation from without, and retains it as long as the agitating *Cause* continues; but forasmuch as the *Cause* ceaseth, and the more thin parts of the *Water* Evaporate, and communicate their *Motion* to the Neighbouring *Bodies*, by this means the *Water* becomes reduc'd to its former state of Coldness.

You'll say, a *Stone* cast up into the *Air*, doth after a short time fall down again to the ground, which would not be, if a *Body* once moved, were inclin'd to continue its *Motion*; for according to this *Rule*, it ought continually to proceed, tending upwards.

I answer, that a *Stone* falls down to the ground, not because it willingly desists from its *Motion*, but because it is hindred by the *Bodies* it meets with on its way from proceeding any further. For the *Air* and *fluid Matter* that is in it, do not without difficulty admit the entering of other *Bodies*; yea and besides do very much resist them, as is obvious to our sense of *Feeling*. For the subtil *Matter*, which thrusts *Bodies* downward, hinders the *Stone* from being carried up to Heaven. So that we ourselves, when we leap up from the *Earth*, should still continue in the same *Motion* mounting upwards, if the subtil *Matter* which surrounds the whole *Earth*, did not drive us downwards.

What hath been said of a *Stone* falling to the Ground must likewise be understood in General of all other *Bodies*: Wherefore if we see a *Body* in its *Motion* describing the four sides of a *Square Figure*, we must conclude that at every one of the said *Angles* where it changeth its determination, it hath been forc'd to it by the meeting of some other *Bodies*, which have oppos'd its *Motion* and determination. And forasmuch as a *Circle* is Equivalent to a *Figure* of an infinite number of sides, it follows, that a *Body* which is circularly moved, must suffer a continual violence by meeting with several other *Bodies*, for without this it could never move in a round *Line*.

But the chief reason that moves us to assert, that a *Stone*, or any other *Body* would persevere in its *Motion*, if we were not hindred by other *Bodies*, is, because *Rest* is contrary to *Motion*, and nothing by its natural Propensity tends to its contrary, that is, to its own *Destruction*; and consequently a *Body* if once moved will move always, or if at rest, will always continue so. And in this Principle alone we place the *Power* of the *Action* and *Resistance* of *Bodies*. For as a thing that is united, hath a *Power* to resist its being separated from that which rests, to oppose that which would put it into *Motion*; so that which is moved hath a *Power* to continue in its *Motion* with the same *Swiftness*, and towards the same place.

Thus a weight hanging at the end of the *Pack-thread* A B which by outward force is mov'd this way and that way, if it were transmitted to G, would fall down thence, and mount up to D, and always retain this *Equality* of *Motion*; neither would it ever, by slackning of its *Motion*, come

H h

VIII.
Every change proceeds from outward Causes.

IX.
Why a Stone after some time, falls down again to the ground.

X.
Answer.

XI.
No body moves circularly but by the intervening of outward force.

XII.
Another reason why Bodies persevere in their motion.

XIII.
Why a Body ceaseth to move.

Figure 5.

down

XIV.
The Second
Law of
Nature.

down to E and F, but that the *Air* hinders it from continuing its begun Motion from G to D. Forasmuch as no reason can be assign'd, why that which is, should cease to be, except a more powerful thing do hinder and oppose its force.

The Second Law of Nature is this: *Every Body in Motion, of it self tends to prosecute its Motion according to a right line, and not according to a crooked line.* Notwithstanding that, many Bodies are forc'd to turn aside by their meeting or jostling against other Bodies, and that, as hath been said before, the whole circle of Bodies moves together in every Motion. This Rule is infer'd from the Definition of Motion, because it affirms nothing concerning Motion, save only that it is a Translation of one Part of Matter, out of the Neighbourhood of those Bodies that do immediately touch it, &c. into the Neighbourhood of other Bodies. So that except this Translation be most simple, that is, by right lines, and not crooked, we have attributed something to Motion, which is not contained in the Essential Notion or Definition of it, and so consequently that which doth not belong to its Nature. For whatsoever is moved, in every moment of its Motion, is determin'd to continue its Motion to some part or other, in a Right Line. Forasmuch therefore as God preserves Motion in the most simple manner that may be, and every natural thing continues in the state wherein it is, the Body moved will always continue its Motion in a Right Line, except it be hindered from without.

XV.
Why every
Motion
tends to a
Right Line.

If you demand why every Motion tends to a Right Line, and not to a crooked? I answer, because all the least parts that are found in a Crooked Line, are right Lines; and since the circulating Body, ultimately exists in one of them, it follows according to the former Rule, that as soon as it is restor'd to its Liberty, it perseveres in the same state, and continues its Motion in that Right Line which there toucheth the Circle. But if the least parts in the Circle were crooked, the moved Body being continually carried along them, and afterwards left to its Liberty, according to the foregoing Rule, would pursue a crooked Motion, conform to the crooked particle of the Circle where it was last: But since this doth not happen, it is manifest that every Circle in Nature is a Polygon, or a Body of many Angles.

XVI.
Both the
Laws de-
monstrated
from the
Divine Im-
mutability.

This Rule of Nature, as well as the foregoing, may be demonstrated from the consideration of the Divine Perfection, that is, from the immutability and simplicity of that operation whereby God conserves Motion in the Universe. For as God preserves Motion in any Body, by making that Motion which now is, to continue to exist, without any regard had to the state wherein the Body was before; so he likewise continues to direct the Body moved to that Term, to which it is directed, at the present instant of time. But there is never any instant of time wherein it is not disposed to continue its Motion in a Right-Line, tho' before it was carried in a crooked line, and accordingly will pursue its motion in a Right-Line. This is clearly made out by DES CARTES in the 2d part of his Principles, Artic. 39. by the example of a Stone A, whirled about in a Sling AE, which tho' it be turn'd round in the Circle LABF, yet withal hath a tendency towards the Tangent Line ACG. For tho' the Stone first proceeds from L to A by a crooked line, yet nothing at all of that

Figure 6.

Obliquity can be understood to abide in it, whilst it is in the Point A. Because tho' the Stone be moved round, yet forasmuch as in every moment of time, parts may be assign'd that have no crookedness at all, it cannot be suppos'd to retain any obliquity, when the detaining force ceaseth.

Hence it follows, that no Body of it self is moved in a Circular Motion, forasmuch as that always proceeds from an outward cause, which hinders the Body moved to pursue its Motion in a Right Line. Upon this account it is also that Wooden Bowls dashing against one another, are often whirled round; and so Water likewise, when it is hastily poured into any Vessel: Yea, in every motion there is a circulation of Bodies, as shall be shewed hereafter.

Another Confectary is, that all Bodies circularly moved, do either actually recede, if they be not hindered; or endeavour to recede, if they be, from the Center of their Motion: Because, as soon as the detaining force ceaseth, they begin to move in a Right Line. This is the reason why the Water doth not fall down out of a Bucket of Water as long as it is whirled round; and that it strives to recede from the Center, we may gather from hence, because upon making a Hole in it, the Water runs out immediately. This Rule is of very great use for explaining of the Heavenly Phenomena. Now this strife of receding from the Center, is either greater or lesser, proportionable to the Agitation, as any one may plainly perceive in the whirling about of a Sling.

Forasmuch therefore as all Bodies moved round, strive to continue their Motion in Right Lines; it follows, that when many Bodies are so moved, every one of them must strive to move by the Tangent ACG of the Circle which it describes; and really move by the same Line, as soon as the causes that have hindered it be taken away. It is visible also that the most strongly moved Bodies, must at the same time describe longer Tangents than those that are more weakly moved, and consequently more withdraw themselves from the Center of their Motion, and by the same means force the weaker Bodies to approach to the Center.

Another Rule is; *Whensoever the Moved Body, meets with another Body in Motion, if it have not as great a force to pursue its course by a Right Line, as there is in the other Body to hinder it, then it is turn'd out of its way, but yet continuing its Motion, loseth only the Determination of it.* As it is evident in hard Bodies, which when they dash against another Body, do not therefore cease to move, but are reflected to the opposit part. But if one of them have a greater force than the other, then it pusheth it along, and as much of its own force as it imparts to this other Body, so much it loseth; as when a hard Body meeting with a soft, by communicating its own Motion unto it, ceaseth to move and lies still. Wherefore we are not to suppose that when a Ball is thrown into a Heap of Sand, that its Motion is lost, but that it is communicated first to the Particles of Sand, next to the Air, and other neighbouring Bodies, notwithstanding the said communication be not visible to our Eyes.

The

XVII.
The Circu-
lar Motion
of a Body
proceeds
from a
Cause Ex-
ternal.

XVIII.
Every Body
that's
whirled
round, en-
deavours to
recede from
its Center.

XIX.
And that
which is
strongest
doth the
more recede
from the
Center.

XX.
The Third
Law of Na-
ture.

XXI.
The Reason of the Third Rule.

The Reason of this Rule is to be fetch'd from the First; for seeing every thing inclines to continue in the state wherein it is, it will follow that that which is weakest must be changed by the stronger, as experience teacheth.

XXII.
From this Law arise those changes which happen to Bodies upon their meeting one another.

From this Third Law ariseth almost all the changes we find in Bodies, caused by the various resistance and occurrence of other Bodies; the effect of which occurrence will be different. First, according to the magnitude of those Bodies. Secondly, according to their Superficies, whereby they press upon each other. Thirdly, according to the swiftness and force of their Motion. Fourthly, according to the Rest and contact of Parts in that Body against which another dasheth, as shall be more amply shewed Part V.

XXIII.
How to measure the Quantity of motion.

The Quantity of Motion in a Body is known partly by the length of the Line which the Body moved runs through; partly from the quantity of its Bulk, which is transferr'd together with it. Thus a Square Body of one Foot, being moved the length of 10 Ells, is said to have a certain Quantity of Motion, which would be double, if an equal way, were added to the former length, which that Body shall run through. Again, if a Square Body of one Foot, should run through the space of 10 Ells, there would be a double portion of Motion in it, with respect to a Square Body of half a Foot. Whence it follows, that Bodies of different magnitudes, may have the same quantity of motion. Thus the Square Body of one Foot, and that of half a Foot would have the same quantity of motion, supposing the former to run through a Line of five Feet, and the other a Line of ten Feet.

XXIV.
Unequal Bodies may have an Equal quantity of motion.

From hence it is evident, that to the end two Bodies of different magnitude may have an equal quantity of motion; it is necessary that the Lines they run through, be reciprocally taken according to their bigness. As supposing one Body to be thrice as big, as another, it is necessary that the Line it describes by its motion, be only the third part of the Line, the lesser Body runs through. And upon this ground we may build these four following Maxims.

XXV.
The First Maxim.

Two equal Bodies, have equal Quantities of motion, when in equal time, they describe equal Lines.

XXVI.
Second Maxim.

Two equal Bodies have unequal quantities of motion, when in equal time, they describe unequal Lines.

XXVII.
The Third Maxim.

Two unequal Bodies have equal quantity of motion, when in an equal space of time, they describe Lines, which are of a reciprocal Proportion to their magnitude.

XXVIII.
The Fourth Maxim.

Two unequal Bodies have unequal Quantity of motion, when in equal time they describe Lines which are not reciprocal to their Bulk.

CHAP. XVI.

A Body can neither move it self, nor another Body.

I.
Motion is something distinct from the force that moves.

TO know whether the Body moved hath its motion from it self, or whether it receives it from some outward Cause, we are to suppose two things in motion; the one residing in the thing moved; and the other in the mover: The former of these is the successive application of the Body moved, to the different parts of the Body that doth immediately touch it; and the second is,

the force that causeth this application. Motion in the thing moved is nothing else but a mode, as hath been said in the foregoing Chapter; and consequently cannot pass from this Body into another, because every mode is inseparably tyed to its Subject. But motion consider'd with respect to the mover, is not a mode of the Body moved, because we find by experience that it passeth from that Body into another; so that motion in the first Sense, is only modally distinct from the Body, whereas the efficient mover is Really distinct from it.

It is evident therefore that a Body hath not its motion from it self, in the first of these Senses, because this motion consists in an Application which is Accidental to the Body; and that every change which happens to any Subject, proceeds from an External Cause. Neither can it give it self the Efficient motion; because this motion likewise is Accidental to the Body: Wherefore it follows that the Body must receive its motion from something that is without it.

Moreover, a Body cannot be said to have that of it self which it may lose, without ceasing to be what it is; now it is evident that every Body can wholly lose its Motion, without ceasing to be a Body: Wherefore we must conclude that no Body has any motion of it self.

If a Body of it self had the Power to move it self, this Power would be Essential to it, and consequently the Body would move always, and with the same force, which is contrary to experience, which teaches us that a Body sometimes moves more, and sometimes less, and sometimes not at all: Wherefore it receives its force to move from something without it. Now there is nothing without or external to matter but Spirit; it is Spirit therefore that moves the Body, that is to say, God, who makes the parts of matter apply themselves successively, as to their outides, to other parts that immediately touch them. Wherefore, since God cannot produce motion without acting, nor act otherwise than by his Will; we must own that the moving Power is nothing else, but the Will God hath to move the matter. Whence it follows also, that as the Will of God is unchangeable, the quantity also of the moving force must always continue the same, and that if it change by encreasing or diminishing, this is not with respect to its Principle, but with respect to the different Bodies on which God exerts that Power, as we have already shewed.

From whence we gather this Conclusion also, that no Body can move another. For how shall it move another Body, seeing it cannot move it self?

If you say that the Power of moving is not distinct from the thing moved, and that therefore it is not repugnant for a Body to apply it self to divers places: If it were so, it would follow that the force whereby God produceth motion in the Universe, must include the notion of Extension; and seeing the same is not distinct from God, it would follow, that God is Corporeal.

Wherefore, ARISTOTLE 8 Physic. Chap. 4. tells us, that no Body can be moved by it self, and consequently that Heavy and Light Things are not moved of themselves, but by others. For if they could move of themselves, they might also stand still of themselves; for whatsoever is a cause of walking to it self, is also the cause of not walking; wherefore if Fire of it self did move upwards,

II.
Every Body is moved by another.

III.
A Body may not be moved at all.

IV.
If a Body were mov'd of it self, it would be in perpetual motion.

V.
Neither can a Body move another Body.

VI.
The Power of moving differs from the thing moved.

VII.
Aristotle teaches that no Body can be moved by it self.

it

it would also be able by its own strength to move downwards. For it is not, saith he, agreeable to Reason, that those things should only be moved one way, that do move themselves. Moreover, how can it be that a continuous thing should move it self? For as far as any thing is one and continuous, it is not capable of Passion: But as soon as it is separated, then one can act and the other suffer. Nothing therefore moves it self, because every thing is one and connext; nor another, that is one continuous thing with it, but in every thing it is necessary that that which moves, should be divided from that which is moved.

VIII.
Bodies
have only
a Disposi-
tive Princi-
ple to moti-
on.

And tho' ARISTOTLE in the place before quoted, seems to own a Principle of Motion in Inanimate Bodies, this is only to be understood of a Dispositive, and not of an Active Principle; after the same manner as a Knife, Sword, Leaver, or any other Engines, are fit or disposed to act something, and do moreover act and move, when they are employ'd by an External Agent, but never can set upon a work of themselves.

IX.
The moving
force is
different
from the
moved.

To make this the more evident, let us suppose that all the parts of matter from the Beginning were destitute of all motion, and to have lain mingled together, having Extension only. Which of all these think you, would have begun to move first? Or what force could they have had to move either themselves or others that touch'd them? Seeing therefore we can conceive nothing there, besides Extension, and that Motion is not an effect of Extension, we must say, that none of them could have the Power either of moving themselves or other Bodies. And what we conclude of the several parts of the matter contained in the Chaos, the same we must conclude of the whole: For whether could that vast Body move, seeing that it is indefinitely extended, and we can conceive no Bounds or Limits in it?

X.
Supposing
things to be
without mo-
tion, there
is nothing
whence they
should be
moved be-
sides God.

We must conclude therefore, that no Body can move it self, since the force of moving is distinct from it; nor another Body, since a Body that moves another must lose as much of its own motion, as it imparts to the other Body: But how shall it impart that which it hath not? Wherefore God must be concluded to be the Author and Principle of all motion in the World.

XI.
How Ani-
mals move
themselves.

If you object, that Animals do move themselves, without requiring an External Cause by which they might be moved. I answer, that the motion of Animals depends on that of the Animal Spirits which being of a fiery nature, and carried through the Body like a Flame or Wind, do easily move the Members of it. For in the Animal Spirits, besides the thinnest and most moveable Particles of the Blood, is also contained much of the Celestial matter, which because of the extream subtilty of its Parts, is perpetually and necessarily agitated. Forasmuch therefore as these Spirits being either simply moved or determin'd, or besides also altered, do easily diffuse themselves into the Nerves, which are extended from the first Original of Sense and Motion to the Muscles and parts to be moved; it is not difficult to conceive how the Figure of the Muscles being changed by the Influx of Spirits, by their contraction or extension, do contract or extend the parts to which they are joyned, and consequently can be moved with innumerable different motions.

C H A P. XVII.

Concerning those Motions which commonly are ascrib'd to Nature's avoiding of a Vacuum.

SOME are so liberal as to allow Knowledge indifferently to all things, and suppose Inanimate Things to be indued with a kind of Intuitive Perception. For if you demand of them why a Stone tends downwards, why Water gathers up it self into round drops, why Plants delight in such and such ground; they have a cause ready at hand, viz. That a Stone tends to the Center of the Earth to rest there; that Water affects a Round Figure, to preserve it self from its Enemy; and that Plants delight in such a Soil, because they know their convenient Aliment; and that Water mounts up on high, to avoid a Vacuum, and to preserve the Union that is between Bodies. Yea, we shall hear some boldly asserting, that the Earth for no other Reason, took to it self a Spherical Figure, than that it might be able, to resist the impulses, of the Heavenly Bodies; and that as with an Army in Battle-array, it might be in a better condition to oppose its Adversaries which on all sides press in upon it.

I.
'Tis absurd
to attribute
knowledge to
Bodily
things.

Thus they tell us, that the Water mounts upwards in Hero's Fountain, because Nature abhors a Vacuum. Which way of speaking hath always appear'd very strange to me, and much like that, as when a Man being demanded why Coals are brought to London from the North parts of England, should answer, for fear of Cold: For these answers do not in the least satisfy the Question, which is not concerning the Final, but the Efficient Cause. Neither indeed can the Avoiding of a Vacuum be said to be the Final cause of the Waters Ascent; First, because the Fear of a Vacuum is vain; neither can Nature abhor that which cannot be; and consequently a vain cause is ascrib'd to those Natural Effects, which are suppos'd to proceed from this fear. Secondly, forasmuch as this Fear is perpetual, and that there is a continual necessity that all Bodies be united together, therefore the Water ought to ascend perpetually, which is contrary to experience; for we find that in Spouts and Pumps the Water ascends only to a certain degree, viz. to thirty one Foot and an half, where it stops, and can rise no higher.

II.
The impro-
per Answer
of some
Men.

Now the Reason why Water can only be raised to a certain height, is this, because the weight of the pressing Air, is then, as it were of an equal poise with the weight of the Water that is driven upwards; so as that the force of resisting in the Water, becomes equal to the pressing force that is in the Air. Thus by Example, from the waters mounting continually in Pumps to the height of about 31 Foot and an half, above the Surface of the Water in which the end of the Pump is dipt, they conclude that a Column of Water of that height weighs as much as a Column of Air of the same bigness, how high soever it may mount.

III.
Why Water
can only
rise to a
certain
measur.

Now to the end that the Cause of these motions may be the better understood, we'll take for granted what hath already been proved, that no Body moves it self, but must be moved by another Body, that immediately toucheth it; pushing against it: And forasmuch as in all the Instances we shall here alledg, nothing is found besides the Air, that toucheth

IV.
No Body is
moved but
by that
which im-
mediately
toucheth it.

toucheth the *Bodies* moved, we must conclude that they are pushed on by the *Air*. Moreover considering that the *Air* always retains a great *Quantity* of watry *Particles*, which tho' dispersed in divers places, do notwithstanding retain their own *Heaviness*, we cannot doubt that the *Air* is *Heavy*, and that by its weight it presseth the *Bodies* it lies upon. As may be seen in a *Syringe*, out of which if we draw the *Sucker* a little way, it of itself runs to the bottom again, because the *Air* that is above it, and immediately toucheth it, by its weights presseth it down to the bottom.

Moreover, we are to suppose, that seeing there is no *Vacuum* in *Nature*, when one *Body* is moved, the same must come into the place of other *Bodies*, and that which is driven out, must at the same instant take up the place of another *Body*, and so consecutively one after another, till the last *Body* enters into the place which was left by the first; so that all *Motions* in the *World* are in some sort *Circular*.

These things so far understood, it will be easy to apprehend, that all *motions* which are ascribed to the fear of a *Vacuity*, are produced, for that some *Body* being pushed out of its place, does as much for the *Body* that is next to it, and so on, till the last *Body* enters into the place left by the first *Body*.

This *motion* is evident in a *Bent* or *crooked Pipe*, the shorter leg whereof *BAD* being put into the *Vessel* *E*, filled with *Water* (for it is supposed that the *Liquor* which is in the part of the *Pipe* *FD*, as standing in a *liquor* of equal *Heaviness*, is not at all pressed by it, and therefore has no gravitation at all) and the longer *Arm* *BC* being extended towards the *Earth*; The *Water* that is inclosed in the longer *Arm*, being heavier because of its greater *Quantity*, than that which is in the short *Arm* *BAD*, it must needs by reason of its *Weight* fall out of the *Pipe* *BC* into the *Air*, and by driving that out of its place, presseth the surface of the *Water* *D*, and makes the *Water* to ascend by the short *Arm* *DAB*, from whence it is carried to that place, which the *Water* falling down out of the *Arm* *BC*, hath forsaken. For seeing that the surrounding *Bodies*, have no place whither to withdraw themselves, they hinder the *Water* and *Air* from entering. But in the longer *Arm* *BC* whence the *Water* falls down, room is made, which the *Water* thrust down by the pressing *Air*, may take up at the same instant.

And the *Water* runs in this *crooked Pipe*, as long as the shorter *Arm* *BAD*, is depressed, or not of an equal height above the surface of the *Water* with the other *Arm* *BC*. But when both the *Arms* are of an even height, the outflowing of the *Water* will cease, for being equal, the one cannot prevail over the other. And if then the same ascent and descent of the *Water* should continue, it would follow that there must be a greater quantity of *Water* in the *Arm* *BC*, than in the *Arm* *BAF*, which is contrary to our supposition.

This shews clearly why the *flux* of the *liquor* from these *Pipes* is swiftest at the first, and afterwards decreaseth by degrees, because the *Arm* from whence the *Water* runs out, is at first higher than the other, which height being continually lessened by the *efflux* of the *Water*, the swiftness of the

motion of the *liquor* must be proportionably diminished. And when both the *Arms* are of an equal height, the *efflux* must cease, and the *Water* be at a stand in them both.

Wherefore no wonder that they lost their labour who endeavoured by the weight of the *Water* in a crooked *Tube* *ABC* to find out a *Perpetual Motion*. For observing that much *Water* was contained in the wider *Arm* *A*, and that the longer *Arm* *C* contained only a little *Water*, they hoped that the *Water* enclosed in the *Arm* *A*, because of its quantity and weight, falling down through the hole *F*, would have sufficient force to press the *Air* *G*, and by means thereof also pressing the surface of the *Water* *D*, contained in the *Tube* *E*, might drive the *Water* through the longer *Arm* *C*, into the *Arm* *A*, and from thence falling down again through the Hole *F*, of the wider *Tube*, into the *Tube* *E*, might produce a perpetual motion of the ascending and descending *Water*.

But this was but a vain attempt of theirs; for tho' all the *liquor* contained in the wider *Arm* *A*, be much more heavy than what is in the longer *Arm* *C*, yet because the *Water* that is contained in the *Globe* *A*, doth not with its whole *Body* press the subjacent *Air*, but only with that part of it which perpendicularly answers to the Hole *F*, it cannot remove the *Air* that is under it out of its place, and consequently neither can it repel the *Water* contained in the *Arm* *CB*, into the other *Arm* *BA*, because the *Water* in *CB* exceeds that in weight which in the *Arm* *A* perpendicularly answers to the Hole *F*. And the reason why the whole *liquor* which is contained in the *Arm* *A*, cannot press all the subjacent *Air*, is, because the other parts of the *Water* contained in the longer *Arm*, falling down perpendicularly, tend directly to the parts of the *Arm* *HI*, diametrically under them, and therefore no wonder if they cannot press the subjacent *Air*; otherwise the *Water* *FB*, which is the lighter, would by its pressure raise up the heavier *DCB*, which no *Naturalist* can admit.

The same cause that makes the *Water* ascend by the foreaid *crooked Tube*, raiseth it likewise by a long shred of *Cloth* or *Linnen*. For first of all the piece of *Cloth* must be well dipt in the *Water*; because as long as that part which hangs down without the *Vessel* is dry, no filtration will follow: Now the outward parts of *Water*, wherewith the *Cloth* is made wet, do so insinuate themselves between the Threads of it, as to make a kind of *Tube* or *Pipe* (but into which no *Air* can enter) and in the mean time the consequent parts of the *Water*, which are contained in the said *Pipe*, flow towards that part of the *Cloth*, which hangs lower down on the outside of the *Vessel*, in like manner as it happens in the *crooked Tube* or *Pipe*.

Thus likewise we see how a *Belows* by being distended, becomes filled with *Air*; for seeing all places are full, and no *Vacuity* is found in the *Universe*, by distending the *Belows*, the *Air* is driven out of its place, and finding no other passage, is forced to enter by the *Nozzle* of the *Belows*.

Respiration also is performed in us much after the same manner: For the *Air* entering into our *Bodies*, dilates the same by means of the *Muscles* of the *Breast* and *Stomack*; whereupon the neighbouring *Air* because of its fluidity is easily turned out

X.
The Motion of Water through a Pipe cannot be perpetual.

Figure 8.

XI.
The Reason of the former assertion.

XII.
How water is drawn out of a Vessel by a Filter.

XIII.
How the Air is drawn into a part of Bellows.

XIV.
How the Air is drawn into our Breast.

V.
In every Motion the whole Circle of Bodies moves.

VI.
How those Motions are performed which are commonly ascribed to the fear of a Vacuum.

VII.
How the Water comes to ascend by a crooked Pipe.

Figure 7.

VIII.
How long this ascent and descent continues.

IX.
Why the flux of the water is by little and little diminished.

out of its place, and consequently drives before it that also which is next to it, and thus the *Air* being pushed by the *Breast*, and other subsequent *Air*, is thrust down through the *Winde Pipe* into the *Lungs* and *Breast*, and from thence also does return the same way. For *Respiration* is nothing else but an Alternate expansion and contraction of the *Breast*, by which the *Air* is thus driven to and from the *Lungs*.

XV.
Respiration cannot be performed by Attraction.

By this experiment we may solve all, or most at least of those *Phænomena*, which *Philosophers* have attributed to *Attraction*. For it cannot be understood how in *Respiration* the *Air* is sucked in, or by what means the *Lips*, *Lungs* or any other part of the *Body* can hook in the little *Particles* of the *Air* and attract them: But when the inward parts are dilated, we easily apprehend that at the same time they push away the neighbouring *Air*, which partly by this *pressure*, and partly by the *Elastick* virtue caus'd by the Agitation of its *Particles*, is driven into the *Breast*, and afterwards expell'd again, viz. when the *Lungs* subside again and are contracted.

XVI.
How the Flesh of mans Body comes to rise up into the Cupping Glasses.

We must not omit here the Experiment of *Cupping Glasses*, by means whereof the *Flesh* is raised in order to *Scarification*, and by force driven into them. For the *Air* being in a manner wholly expell'd out of the *Cupping Glasses*, by the intromission of *Fire*, it must thereupon be condensed, and its parts more closely prest together, than is consistent with its temperament: And therefore whilst the *Subtil Ether* crouds in betwixt its *Particles*, this *External Air* strives to dilate it self again, and to return to its natural state: And in this strife it presseth all the *Bodies* that do surround it, which as long as they strive against this force, no *Bodies* are turn'd out of their *Places*. But when the *Air* in the *Cupping Glasses* begins to grow cold, it hath no power any longer to resist the *pressure* of the *Air* striving to dilate it self, and therefore suffers the outward *Air*, by pressing the *Flesh* to thrust it into the *Cupping Glasses*, and to drive out the *subtil matter* which was contained in them through the *Pores* of the *Glass*.

XVII.
Much in the same manner as the water mounts upwards.

Almost in the same manner as we see the *Hand* in a *Pneumatick Engine* (after that the *Air* is exhausted out of the *Recipient* or *Glass Vessel*) to swell and spread. And for the same reason, a *Viol* with a narrow *Mouth*, if the *Air* by sucking be drawn out of it, and afterwards you stop the Hole of it with your *Finger*, and so dip it into the *Water*, it will become fill'd with it; because the *Ambient Air* by its weight pressing the *Surface* of the *Water*, drives it into the *Viol*, in which the *Air* that remains, being rarefied, for the want of the *Air* that is extracted, retains only a weak *Elastick* force, and so cannot oppose the *pressure* of the outward *Air*.

XVIII.
How Infants suck Milk out of their Mothers Breasts.

Hence it also appears how improperly *Infants* are said to suck *Milk* out of their *Mothers Breasts*: For if we consider how a *Child* draws *Milk*, we shall find that he doth not attract it by *Sucking*, but that it is driven into his *Mouth*: For the *Child* when it is about to *Suck*, doth dilate his *Cheeks*, and lay hold of the *Nipple*, wherefore the *Air*, that is next to his *Cheeks* must be driven out of its place, which pressing the *Breast* of the *Mother* or *Nurse*, drives the *Milk* into the *Childs Mouth*. And accordingly also *Nurses* use to prest their

Breasts, to facilitate the Expulsion of the *Milk*. And the same doth yet more clearly appear in *Brute Animals*; for *Lambs* use to thrust their *Heads* against their *Dams Dugs*, thereby to squeeze out the *Milk* into their *Mouths*.

CHAP. XVIII.

Of the Determination of Motion both Simple and Compound.

HAVING explain'd the Nature of *motion*, and determined the *Causes* of it, it remains now that we discover its *Properties*, and the *Accidents* that accompany it. The inseparable *Properties*, of *motion* are *Determination*, *Swiftness*, and *Quantity*. For every *Body* that is moved, moves some way or other, runs through a certain *Space* in a certain time, and that *Space* may be divided into certain degrees. Inasmuch that the respect which *Bodies* moved have to the *Coast* towards which they are moved, is called *Determination*; the respect which they have to the *Space* they run through in a certain time, is called *Swiftness*, and this *Swiftness* distinguish'd into degrees, that is, into equal *Parts*, is called the *Quantity* of *motion*.

I.
What the Swiftness, Determination and Quantity of motion is.

The *Determination* of *motion* is that whereby the *Body* moved, is directed from the *Term à quo*, to a certain *Term*: Such as is that disposition in a *Stone*, whereby it tends rather to the *Center* of the *Earth*, than towards any other part whatsoever. We shall the better understand its *Nature* by dividing *motion* into *Straight*, *Circular* and *Mixt*. *Straight motion* is a *Translation* by the shortest way that can be, viz. by a *Right Line*. *Circular motion* is a *Translation* about a *Center* and *Axis*. And *mixt motion* is that which is compounded of a *Circular* and *Straight Motion*, or of two straight ones, or innumerable other various *motions*. As the *motion* of a *Knot* in a *Wheel* about the *Axle-tree*, which is circular, and also straight with respect to the way along which it goeth.

II.
What the Determination of Motion is.

And that a *mixt motion* may be compounded of two *right motions*, is evident, when in the square Figure *ABCD*, the uppermost side *AB*, is moved with a straight *motion* towards the opposite side *CD*, and that at the same time the point *A*, of the upper side *AB*, be moved towards *B*, the other extremity in a straight *motion*. For by this means the point *A*, will not describe a *Perpendicular AC*, but a *Transverse Line AD*, yet a straight one, which *Geometricians* call a *Diagonal*, when it reacheth the opposite side *CD*.

III.
How a mixt motion may be compounded of two straight motions.

Figure 9.

These things being thus briefly laid down, I say, that *motion* consider'd in it self differs from *Determination* towards any *Coast*; which I thus prove. Whatsoever can be taken away from any thing, without impairing of it, that doth not constitute the nature of that thing: But *Determination* may be taken away, the *motion* still continuing whole and entire: Therefore *Determination* doth not constitute the nature of *motion*. The *Minor* is thus proved: Suppose the *Body A*, to move towards *B*, and to be hindered by the *Body B*, from going any further, *A* according to the *Laws* of *motion*, will retain its own *motion* entire: But when it pursues its *motion*, it is no more carried the same way it was before, because it is hindered by the *Body B*: Wherefore its *motion* abiding entire, and having

IV.
Determination is a Mode distinct from Motion.

Figure 10.

having lost its first Determination, it will begin to move the contrary way : And therefore motion is distinct from Determination.

V. This may be proved ; for that motion, as was said before, is not contrary to motion, neither do they ever destroy one another in the same Subject ; whereas one Determination is contrary to another, and the one destroys the other : Wherefore they are different. For proof of the Minor, suppose the Body A, to be bigger than the Body B, and to dash against the Body B, either resting, or more slowly moved, A moving more swiftly, will alter the Determination of B. But if A and B be supposed equal in bigness, and that with a different Determination and equal swiftness they approach to one another, they will fly back from each other the contrary way, with the change of both their Determinations, whilst the same Quantity of Motion still continues in them. Moreover, Motion, and its Determination are two Modes, one whereof may be superadded to the other in the same Subject ; after the same manner as Swiftness and Slowness happens to Running. And therefore as Swiftness may be taken away from the running of a Stag, and is actually taken away, when he runs slowly : So likewise can the Determination of motion be easily changed, the motion it self still continuing.

VI. This will appear unquestionable, if we consider that the cause of Motion and Determination is not one and the same. For that force whereby the mover strikes a Ball with a Racket from C towards B, is not that, by which it is determin'd to tend this way rather than another way, but wholly diverse from it. The force of the Racket is that which moves the Ball, and could as well move it towards any other parts, as towards B. But the Determination depends on the Situation of the Racket, which so disposeth it, as to make it to be carried to B, and might have dispos'd it after the same manner, tho' it had been struck another way. And therefore the Determination of the motion of Bodies does not so much depend on the force of the mover, as on the Situation of the mover, and circumjacent Bodies. Wherefore it is manifest, that it may happen that the Ball being struck from C towards B, may be turn'd aside by meeting with the Earth EF, viz. by a change of its disposition, by which it tended towards B, the force of its motion all this while continuing the same, there being nothing common between them.

VII. Those who do not distinguish the Determination, from motion it self, nor one Determination from another, do suppose that the Motion of Reflexion is contrary to direct motion ; and instead of owning no other contrariety, but what is between motion and rest, they assert, that between reflex motion there is a moment of rest, which is absolutely impossible. For this motion being interrupted, there would be no cause assignable, by which it might be excited anew ; but rather having obtained a new way of Existing, according to the Laws of Nature it ought to continue in the same condition, as much as if it had been at rest for many ages together. Neither is there any more necessity why it should begin to move again, than why a Triangular Body, which by motion is become Spherical, should not retain that Figure, as much as if it had receiv'd it from the beginning.

Because every thing, as far as in it lies, continues in the same state wherein it is.

Determination is double, simple or compound. Simple Determination is that, whereby a Body after a simple manner tends to the Term to which it is directed. Such as is the Determination whereby the Body A, from the same point A, by the right line AB, moves towards the Body EF diametrically opposite to it.

But when a Body falls directly and perpendicularly from A to B, on another hard and unmoved Body EF, it is evident that it must fly back by the same line BA, seeing there is no reason why it should tend to one side more than to another. Yea, forasmuch as the Determination of the Body A, is direct from A to B, and is simple, it is necessary according to the Laws of the unchangeableness of Nature, that it always continue in the same state, without altering.

Compound Determination is, when the Body moved is after a compound manner directed to another Body : As when the Body C, from the Point C, by the Transverse Line CB tends to the Body EF obliquely oppos'd to it. For the Mode of this tendency is compounded of a Lateral Progressive motion CG in length, and a descensory CB in height : Because every motion that depends on two or more causes, is compound. Wherefore, a Bullet shot out of a Canon, doth not describe a straight, but a crooked line only, because two divers causes concur to its motion ; the one driving out the Bullet, which by degrees grows less, since the Bullet, as it proceeds, communicates its motion to the Air, which it thrusts out of its Place ; whereas the other motion, which is descensory, is encreased, daily experience teaching us that Heavy Bodies move more slowly at the beginning of their descent, than in the progress of it.

CHAP. XIX.

Concerning Reflexion and Refraction.

FROM what hath been said, may be easily gathered what it is for a Body to be Reflected or Refracted. For since in Compound Determination the Body moved, meeting with another Body, tho' it keeps the same motion, yet only retains one part of its Determination ; it so happens that because it cannot go forwards, it suffers an Oblique Reflexion towards the opposite part ; but if it can, then Refraction. Hence Reflexion may be describ'd, The Regress or Return that happens to a moved Body, because of the meeting of another Body, which it cannot penetrate. And Refraction, is the incurvation, or change of Determination in the Body moved, which happens to it, whilst it enters or penetrates the Medium.

Thus if a Body moved directly, meets with another that is unmoveable, it must be reflected by the same Line by which it is directly moved, there being no cause to oblige it, to describe any other. For example ; if the Body G be mov'd directly by the Line GB, towards the Earth CE, which I suppose unmoveable, it will not be reflected by the Lines BA, or BF, but by the Line BG. The Reason whereof is, because the Determination of the Lines BA and BF is compounded, and that no cause can be assigned, that should oblige the Body G,

VIII. Determination is either Simple or Compound.

IX. A Body falling perpendicularly upon another Body, must be perpendicularly reflected.

X. What compound Determination is.

I. What Reflexion and Refraction is.

II. Sometimes a Body is directly reflected.

Figure 12.

III.
Sometimes
obliquely.

G, which was moved with one only *Determination* toward the *Earth* CE, to retire from thence with two *Determinations*.

But if the *Body* A be mov'd obliquely by the line AB, and that it meet with the *Earth* CBE, which is suppos'd unmoveable, it will be reflected by the line BF, which is diverse from the line AB. To prove this, draw through the *Points* A and B, the lines AC and HB, perpendicular to CE. This done, consider in the first place that the *Body* A, moving towards B, doth at the same time approach to the lines CE and HB, that is to say, that its *Determination* from A to B, is compounded of its *Determination* from A to C, and from A to H; or that which is the same thing, of its *Determination* from above to beneath, and from the left to the right. Consider in the second place, that the *Earth* CBE opposeth it self to the *Determination* from A to H, and by consequence that the *Body* A, when it meets with the *Earth*, must take a quite contrary *Determination* to that which it had, by which in an equal space of time, it must advance equal quantities; that is to say, if within a *Minute*, the *Body* A, descended by the line AB, to the line CBE, it must in another *minute* remount again from the line CBE by the line BF.

IV.
The Angle
of Reflection
is equal
to the Angle
of Incidence.

But that we may know more distinctly to what part the *Body* or *Ball* struck, must rebound, let us describe a *Circle* from the *Center* B, at the Interval BA: For all the *Points* which are distant the same Interval from B, as A is, do meet in this *Circumference*. Now to be able particularly to determine this *Point*, let us with *Des Cartes Chap. 2. Dioptr.* erect three perpendicular lines AC, HB and FE, upon CE, so as there may be the same distance between AC and HB, as between HB and FE. Next let us say, that in the same space of time, in which the *Ball* hath been moved towards the right from A, one of the *Points* of the line AC, into B, one of the *Points* of the line HB, it must move from the lines HB, to some point of the line FE. For all the *Points* of this line FE, have in this respect the same Distance from HB, as all the *Points* of the line AC, and it is also as much determined to move that way as it was before. Now so it is, that it cannot arrive at one and the same time to any point of the line FE, and to some point of the circumference of the *Circle* AFD, save only at the point D, or at F, because there are none but these two, where they intersect one another: So that the *Earth* hindring it from passing towards D, we must conclude that it must infallibly move towards F. And thus you may easily see how *Reflection* is made, to wit, according to an Angle, which is always equal to that which is call'd the *Angle of Incidence*. As if a *Ray*, coming from the point A, to fall upon the point B, on the surface of a flat Looking-glass CBE, should so reflect toward F, that the Angle of *Reflection* FBE, be neither greater nor less, than the Angle of *Incidence* ABC.

V.
The Angle
of Reflection
is sometimes
less than the
Angle of
Incidence.

Yet it is not necessary that the *Angle of Reflection*, should be always equal to the *Angle of Incidence*, forasmuch as sometimes it may be greater and sometimes less. For suppose the *Body* A, to descend by the line AC, towards the *Body* DE, and to reach the *Center* C, in the space of one *Moment*; and that the swiftness of this *Motion*,

be diminished one half in the *Point* of *Contact* C; it is evident that the *Body* A, being reflected from the opposite *Body* DE, in its *Center* C, cannot in one moment run through an equal line, since it is supposed to have lost one half of its swiftness, and therefore spending two *Moments*, in running through an oblique line, it will by *Reflection* arrive at the *Point* of the *Circle* B, and will there make the Angle of *Reflection* BCE, less than the Angle of *Incidence* ACD. This *Reflection* is commonly call'd from a *Perpendicular*, because the line of *Reflection* BC doth more deviate from a *Perpendicular*, than the line of *Incidence* AC.

But if the *Body* B, be carried to the opposite *Body* DE by the oblique line BC, and arrive at the *Center* C, in the space of two *Moments*, and that its *Motion* be encreased in the point of *Contact*, so as to become twofold swifter, it is evident that the *Body* B, rebounded by the opposite *Body* DE, must in the space of one *Moment*, in its ascent run through an equal oblique line, and arrive at the point A of the *Circumference* of the *Circle*; and so the Angle of *Reflection* ACD, will be greater than the Angle of *Incidence* BCE. And this *Reflection* is call'd *Reflection* to a *Perpendicular*, because the line of *Reflection* AC, doth less deviate from a *Perpendicular* than the line of *Incidence* BA.

What has been said is sufficient to explain the nature of *Reflection*: We proceed now to *Refraction*, which is when a *Body* passing from one *Medium* to another doth deflect from the straight line it described. So that by the *Refraction* of *Motion* nothing else is understood, but the *Deflection* or turning aside, which a *Body* suffers in passing from one *Medium* into another. For the understanding of this *Refraction*, we are to consider, first, whether the second *Medium* resists the *Motion* more or less than the first, and whether the *Body* moved do meet it directly, or obliquely; for if it meets it directly, whether it resist more or less, it is without doubt, that the *Body* moved must in no wise change the determination of its *Motion*, in penetrating of it.

To prove this, let us suppose the *Body* L descending in the *Air* by the *Perpendicular* line LB, and that it directly meet the *Water* which is under the surface CBE, which separates the two *Mediums*: This being so, I say that the *Body* L having pierced the surface CBE, will tend directly towards G, because the *Water* that is under that surface, doth resist it equally on all sides, and that there is nothing but the inequality of that resistance, that can make it turn aside.

On the contrary, if the *Body* moved meets the second *Medium* obliquely, then of necessity it must deflect either to the right or left, according as the second *Medium* resists its *Motion* more or less than the first; as by example, let us imagine a *Ball* struck with a *Racket* from A, obliquely to B, to meet there not with the *Earth*, but with the *Water*, whose surface is bounded with CBE, the *Ball* in this case doth not directly tend to D, but towards I, and this bending or *deflection*, which is measur'd by the Quantity of the Angle BDI, is call'd *Refraction*.

The Cause of this *Refraction* is the Resistance it meets with: For seeing that every thing as much as in it lies continues always in the same state, we

Figure
13.

VI.
When
the Angle
of Reflection
is greater
than the
Angle of In-
cidence

VII.
What Re-
fraction is,
and how it
is made.

VIII.
A Body di-
rectly fall-
ing into
medium re-
sists no Re-
fraction.
Figure 14.

IX.
But if it
falls obli-
quely it is
refracted.

X.
The cause of
Refraction.

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we can give no reason why any *Body* should deflect from the *Straight* way in which it began to move, but because it meets with some hindrance in that part from whence it rebounds. Thus when the *Body A*, after it is arriv'd to the *Point B*, is turn'd aside, and tends towards *I*, we must conclude that it meets with more resistance towards the left side of *B*, than on the right; and if it be turn'd aside towards *D*, that it finds a greater Resistance from the right side of *B*, than from the left. And therefore if we perceive that the *Water* doth more hinder the motion of the *Ball* than the *Air*, we may easily judge that the *Ball* which in the *Air* is moved from the *Point A* to the *Point B*, that from thence it may pass into the *Water*, must pursue its course towards *I*, and deflect from a Perpendicular.

This may be apply'd to all *Bodies* and all the *Mediums* they pass through. Wherefore this may pass for a *Maxim*, that as often as a *Body* moved, passeth from one *Medium* into another, that doth resist it more, it must be refracted, by declining from a Perpendicular. And that on the contrary, when it passeth from one *Medium* to another where it finds less Resistance, there it must deflect towards a Perpendicular.

I have already said that it is necessary to Refraction that the *Body* fall obliquely upon the surface that separates both *Mediums*, that so it may be deflected or turn'd aside. For if it should proceed Perpendicularly, without any Declination, seeing it would not be hindered on the one side more than on the other, from proceeding in a straight line, it could not suffer any Deflection, and consequently must continue its right motion, as hath been said.

To Determine the Quantity of Refractions, we must attend to the particular constitution of *Bodies*, whether they do more or less resist the passage of *Bodies* moved. For suppose we that the line *CBE* separates two *Mediums*, the upper whereof is *Air* and the undermost *Water*, and that the *Water* doth as much again as *Air* resist the motion of the *Ball A*. Suppose we likewise that the *Ball A*, having past the oblique line *AB* in one moment, to meet with the *Point B*, there obliquely to enter the *Water*: And that neither the Bigness, Weight, or Figure of the *Ball* do hinder it from so doing; Yea, and that its motion in the *Air* hath been always equal, and that having lost the one half of its swiftness, by meeting with the *Water*, it loleth now no more throughout its whole Course, how deep soever it may enter the *Water*; because this is nothing to the purpose, since the Deflection happens only in the Surface, and the *Water*, which resists equally on all sides, can only make the *Ball* to spend a greater or less space of time in its motion, but cannot make it to deflect from the Line, which it had begun to move in.

These things being observed, that we may know what way the *Ball A* must take, we are to consider that tho' the motion of the *Ball*, be lookt upon as simple, this doth not hinder but that its Determination in the line *AB*, with respect to the Surface of the *Water*, is compounded of two other motions, the one whereof presseth it from *AF* to *CE*, and the other at the same time presseth it from the left *AC*, to the right *FE*, so that both these together lead it to the *Point B*, by the right line *AB*.

Moreover we are to observe, that of both these *Parts*, whereof we understand that this Disposition consists, the one only is changed by the Surface of the *Water*, viz. that which drives the *Ball* downwards, whereas that which pusheth the *Ball* towards the right hand continues still the same.

Having therefore described the Circle *AFD* from its Center *B*, and having describ'd upon *CBE* three Perpendicular Lines *AC*, *HB*, *FE*, so as that the space between them *FE* and *HB*, is the double of that which is between *HB* and *AC*, we shall find this *Ball* will go on to the *Point I*: for seeing that the Surface of the *Water CBE*, doth exactly take away one half of its swiftness, it must take up a double proportion of the time in which it passeth from *A* to *B*, in passing from *B* to any point of the Circumference *AFD*. And seeing nothing is lost of the Disposition whereby it was carried towards the right hand, in the double proportion of that time, wherein it proceeded from the line *AC* to *HB*, it must go twice the length towards the same part, and consequently approach to some point of *FE* at the same Moment in which it draws near to some point of the Circumference of the Circle of *AFD*, which would be impossible if it did not advance to *I*.

We are also to take notice that the more obliquely a *Ball* dasheth against the Surface of the *Water*, the more it is turn'd aside by it; so that if it be directed to right Angles, as if it were struck from *H* to *B*, it proceeds in a right line without any Declination to *G*, as hath been said already. But if it be driven along by a right line, as *AB* is, and lie so obliquely on the Surface of the *Water CBE*, that the drawn line *FE*, cannot intersect the line *AD*, then will it not penetrate the *Water*, but will rebound from the Surface *B* into the *Air* towards *F*, after the very same manner as if it had lighted on the *Earth*. As we see in those Stones wherewith Boys make Drakes in the *Water*; and as *Bullets* which (according to the Relation of those who have been in Sea fights) being obliquely shot out of Cannons rebound from the *Water*, and hit Men standing on the Decks.

CHAP. XX.

Of the Force of Acting and Resisting.

The force of acting and resisting may be understood two several ways, either Metaphysically, for the Faculty or Power which any thing hath to act or resist. And this is nothing else but a Non-Repugnance to act or resist. So he who saith that a *Needle* can prick, thereby means nothing else, but that Pricking may Coexist with a *Needle*. Or else it may be taken Physically for Reaction, as when any thing that is moved upwards, is driven down by some other Cause, and thus resistance is called Positive; as when two *Bodies* in motion, meeting together, beat back one another; as two *Bullets* or *Bowls* meeting together, by their contrary Determination. Or it is also precisely taken for the force it self of Resisting, as when a *House* resists the *Wind*, or a *Stone* the *Ball* that is cast against it. And this is commonly called Negative or Formal. And it is of these two that we enquire here, viz. to know wherein the force a *Body* has to act upon another, or to resist it, doth consist.

XV. Where the variation is in the Body moved.

XVI. How much the Ball's motion is fore-slowed when it passeth through the Water.

XVII. The more obliquely a Ball falls on the Water, the more is it deflected.

I. The force of acting and resisting taken in a twofold sense.

XI. How a Body comes to be variously refracted.

XII. It is required to Refraction that a Body fall obliquely upon another Body.

XIII. Requisites to determine the quantities of Refractions.

Figure 14.

XIV. How much the Motion of a Ball is retarded by entering the Water.

II.
Wherein
the Power
of Acting
or Resisting
doth con-
sist.

All the Power any *Body* hath to act upon another, and every Faculty, whether *Positive* or *Negative*, of any *Action*, consists in this alone, That according to the forementioned Law of Nature, Every *Body*, as far as in it lies, continues in the same state wherein it is, whether in *Rest* or in *Motion*; because every state of *Bodies* may be referr'd to one of these. So that those *Bodies* which are joyned together by *Rest*, have a power to hinder themselves from being separated, as well as those that are separated, have a Power to continue so; and they that are moved, have a Power to continue their *motion*, according to the same degree of *Swiftness*, and towards the same *Coast*: As that which *Rests* in any place, hath a force to abide there, and to preserve its *Rest*. And this is the only cause of the *motion* of *Things* that are cast or thrown into the *Air*; concerning which we have more reason to enquire how they come to cease from *motion*, than how they continue it so long as they do.

III.
This Force
ariseeth first
from the
Bigness of
the *Body*.

Now this *Force* may be attributed to several Particulars: As first, to the *Magnitude* of the *Body* in which it is found. For it cannot be questioned, but that a *Great Body* exceeds a *Less* in the faculty of *Acting* and *Resisting*, because in regard to the *Parts* of which it is compounded it hath more *Motion* and *Rest*; and seeing every *Body* hath a proportionate Affection answering it, therefore the *Quantity* of these must be answerable to the *bulk* of the *Body*. Hence is that common Saying amongst *Naturalists*, that a thing of greater *Quantity*, hath the greater *Virtue*: Which *Virtue* is to be esteemed according to the force of *Motion* that is in the whole *Body*, or its firm adhering and abiding in a place. Thus *Fire*, the more it is extended in *bulk*, the more violently it burns; and the more fixedly any *Bodies* continue in one place, with the greater difficulty are they thrust out of it. Thus *Round Bodies* are the strongest both in *Action* and *Resistance*, as appears in *Pestils*, *Milstones*, *Cylinders* or *Rolling-Stones*, and other such like *Instruments*, which are the more proper to bruise *Bodies*, and making them smooth or even, because their force is altogether directed to one *Line*. Thus also a *Hammer*, with a long *Handle*, strikes the *Anvil* with a greater force than that which hath a short one.

IV.
Secondly,
from the
Bigness of
the *Surface*.

The Power of *Acting* and *Resisting* is also taken from the largeness of the *Surfaces* of *Bodies*; for the broader the *Surface* of two *Bodies* is, the more firmly do they cleave together; as appears in two *Wooden-boards*, well plained, lying upon one another: Whereas on the contrary, where the *Surfaces* are narrow or little, by so much the less firmly they stick together. Thus *Spherical Bodies* less stick together, because their *Surface* is the least of all *Bodies* with respect to their *bulks*, and they touch each other only in a *Point*. And certain it is that *Lead* made up into a great *Bullet*, is more solid than that which is distended into a thin *Plate*, or made hollow. Wherefore the greater quantity of *Matter* is contained under a little *Surface*, the more solid it is, and of the greater efficacy to resist; as is evident in *Gold*, *Lead*, *Iron*, and other *Metals*, which being once put into *Motion*, retain a greater force to preserve and continue it, than either *Wood* or *Stones* of the same *bulk* or *figure*. But on the contrary, *Triangular Bodies*, and such

as have more *Surface* than other *Bodies* proportionably to their *Extension*, are more difficultly moved, and have less force to continue the same, or to resist other *Bodies*.

The said Faculty of *Acting* and *Resisting* may likewise be estimated, from the *swiftness* or *slowness* of *Motion*. For a little force resists *Bodies* that are swiftly moved; as when we lash the *Water* with a *Rod* or *Wand*, we find the *Water* to resist the *Rods* entrance. Because (as hath been hinted heretofore) the *Strife* of *Material things* in *Acting* and *Resisting*, depends on the determination of the *Motion* towards some certain *Part* or *Coast*, and its meeting with a *Body* resting there, or otherwise moved. And a *Body* is then taken to be otherwise moved, when it is either moved more slowly, or another way.

This *Force* may also be gathered from the nature and contrariety of the *Mode* or *Manner* whereby divers *Bodies* meet with one another. For according as they are variously oppos'd to each other, so they have a different force of *Acting* and *Resisting*. Thus a *Stone* slantingly thrown on the *Surface* of the *Water*, so as to leap from it, cannot divide the *Top* of the *Water*, as if it had been downright cast into it.

From these Four Particulars, to which all *Action* and *Resistance* of *Bodies* may be referr'd, we may determine how *Bodies* do increase, or diminish their *Motions*, or change the determination of them, (for there is this threefold difference in *Motion*;) only we are to observe how much *Force* there is in every *Body*, either to move or resist *Motion*, and certainly conclude, that that which is strongest, always takes effect. Thus the *Motions* of *Great Bodies* have their *Force* from the *Agreement* of their *Parts*, though their *Motions* have but few degrees. So *Stones*, and even *large Buildings*, are oft forc'd to give way to a *River* that runs but slowly. And upon the same account, in other *Bodies* also the *motion* may be strong, tho' it be not swift: And on the contrary in less *Bodies*, there may be a considerable swiftness of *motion*, and not any great force. As if the *Body A* (for Example) should be moved as swiftly again as *B*, and the *Body B* should exceed *A* in bigness in a double Proportion, in this case we must estimate as much *Motion* to be in one, as in the other; because the *Extrusion* which is found in the *Greater Body*, is by its *bulk* equivalent to the *Intention* of *Motion* in the other.

Now in the opposition or meeting of *Bodies*, this Rule always holds good; *Whatsoever exceeds another thing in strength, obtains its effect*, whether it be in moving another *Body*, or in resisting its *Action*. And therefore of those things that tend to the same place, if it be not large enough to contain them all, the strongest only do get thither, leaving the weaker behind them. Thus the most lively and vehemently moved *Particles* of the *Blood* are received into the *Cavities* of the *Brain*, the weaker being hindered by the stronger from arriving there; because the *Passages* of the *Brain* are too narrow, than that all the *Particles* of the *Blood* can get up thither.

V.
Thirdly,
from the
Swiftness
of *Motion*.

VI.
Fourthly,
from the
Meeting of
Bodies.

VII.
A threefold
Difference
is incident
to *Motion*.

VIII.
That which
is strongest
always ob-
tains its
effect.

CHAP. XXI.

Of the State of Bodies ; and first those that are Hard, Fluid, Frangible, Friable, Soft, Ductile, and such as may be cut or slit.

I.
Whence the Hardness of Bodies proceeds.

AMongst the Principles of Natural things, MOTION and REST only are opposed to each other, not privatively (as some would have it) but contrariously, as two Modes really distinct. For Rest or Quiet is not a Privation of Motion, but a true Form, whereby Stable and Hard Bodies are distinguish'd from such as are Fluid, and whence they receive the force of Acting and Resisting. For those Bodies are accounted Hard, whose Parts by a firm Union lye still together; or whose Parts do so closely cleave together, that they cannot without difficulty be separated. Which close Union is perceptible to the Senses; for if we touch any of these Hard Bodies with our Hands, or any other part of our Body, they resist them, and oppose their entrance; as we see in Marble, Wood, Stone, &c. for if, when they are handled by us, they give way, we should perceive no Sense of Hardness at all; as appears by the Air, which is not felt by us, because it gives way to our touch.

II.
What is the Cause of the variety of Hard Bodies.

The Hardness of Bodies is various, according to the variety of Rest; for wheresoever there is more of Rest, there also is more of Hardness; and so contrarily. Clay, when the Water is evaporated from it, grows hard, because the Rest of its Parts is by this means increased, its Earthy parts being delivered from the Agitation of the Fluid parts, interpos'd between them; whereas Wax being heated, becomes soft, because the Rest of its Parts is lessened, by reason of the Oily Particles, which being benum'd before, are by the Heat put in motion.

III.
What Hardness is.

When we say that Rest is the Cause of Hardness, we mean the Formal, not the Efficient Cause; for the Efficient Cause of Hardness consists only in the force wherewith the Air, or other Subtil Matter, compresseth the Parts of Hard Bodies. To the end therefore that we may have a distinct Idea of Hardness, we must conceive it to be nothing else, but the Rest of many parts of Bodies, caused by the Pressure of the Air, or the Subtil and Aethereal Matter, which acting from without, drives these parts inward in such a manner, that they cannot be separated afterwards, without making us sensible of their Resistance.

IV.
What is the Cause of the Fluidity of Bodies.

Fluid Bodies, on the contrary, readily yield to the motion of other Bodies, and therefore do not resist our Hands when we touch them, as appears in the Water and Air. The Cause of which difference consists only in Rest and Motion: For if we enquire why some Bodies cannot but by force be thrust out of their places; whereas others without any difficulty yield the place they are in possession of, to others, we shall find that the Reason is, because their Parts, which resist those Bodies that approach to them, lye still and Rest; whereas the Parts of other Bodies, that without any force do leave their places, are in motion. So that Hard Bodies are such, whose Parts lye still and cohere together; but Fluid Bodies are divided into many little Parts, which are variously moved. For the Parts of Water, or any other Liquor, are

agitated every way by the Subtil and Aethereal Substance: And accordingly those Bodies are called Fluid, whose insensible parts have such various Motions.

Now that the Parts of a Fluid Body are moved, and that equally every way, appears from hence, that in what part soever of a Fluid Body we do move our Hand, or a Stick, it always goes on with the same easiness, which could never be, if the Determination were stronger one way, than it is another. Tho' it cannot be deny'd, but that some Resistance is found in a Fluid Body, if we swiftly lash any thing against the Parts of it; because a Body slowly moved, comes under the Notion of a Body at rest, when compared with a Body that is much more swiftly moved, and consequently will resist it.

Hence it is that the Figure of Fluid Bodies is undetermin'd, because they are so easily divided and diffus'd, that they cannot keep themselves in their own bounds. But Hard and Stable Bodies being hard to be divided, easily retain their Figure, and are easily comprehended within their own limits; as appears in Lead, Iron, Silver, Gold, Wood, Marble, &c. which according to their several degrees of Solidity preserve their figure and Bulk. That therefore we call a Fluid Body, whose Parts being divided into many small Particles, and these again into less Indefinitely, are variously agitated. But that is called a Hard Body, whose Parts by Rest do so closely cleave together, that they cannot be separated, but by a Force sufficient to overcome their coherence.

The smaller and lighter the Parts of any Fluid Body are, the greater is its Fluidity; and the thicker and more Branchy they are (if Contact doth not hinder) so much the less is it. Hence arise the diverse kinds of Fluid Bodies, according as by the lightness and smallness of their Particles, they are more, or according to the Thickness and Branchiness of them, less yielding to the Celestial Matter, which is the Cause of their Fluidity. Upon this account it is that the Air is more fluid than the Water; because the Parts of Water, tho' they be smoother, yet are thicker than those of the Air. And Water is more fluid than Oil, because the Parts of Oil are more thick and branchy: Lastly, Oils are more or less fluid, as their Particles are more or less thick and branchy.

When I say that the Nature of Liquid Bodies consists in Motion, it is not so to be taken, as if the whole Liquid Body were moved out of one place to another, for this happens also to Hard Bodies: For a Bowl of Brass is easily rowl'd from one end of a Table to the other, and for all that persists to be a Hard Body; but in this, that the Particles into which they are divided, are moved and variously agitated, some of them being tost to the Right, others to the Left; some upwards, others downwards; some forwards, and others backwards: Which Motions of the Particles must be different. For if they were all of them carried one way, they would in a short time cling together, and make up a stable or hard Body.

And tho' the Course of a River be directed to one particular part of the Land, it does not therefore lose the Name or Nature of a Fluid Body; forasmuch as the various Motion of the Particles of the Water is preserved, notwithstanding the fluid

V.
How it appears, that the Parts of Fluid Bodies are agitated every way.

VI.
Fluid Bodies have no certain figure, as Hard Bodies have.

VII.
The various kinds of Fluid Bodies.

VIII.
How Fluid Bodies are said to be in Motion.

IX.
Why it is carried with a greater Force, than the Water.

said Course of the River, as much as in a still *standing Water*. Hence it comes to pass, that *Ice* driving on the top of the *Water*, because of the firm clinging together of its *Parts*, doth with a greater force pursue its way, and with more violence set against the *Banks*, than the *Water* it self which carries it; because the *Parts* of *Water* being soft with various *Motions*, weaken the force of it, and therefore cannot stand with that vehemence to one part, as the *Ice*, which is a *solid Body*, doth. By which Example it is evident, why *Fluid Bodies* easily give way to other *Bodies*, but *solid Bodies* not; because *Fluid Bodies* are always in *Motion*, and therefore do not oppose the entering of other *Bodies* into the places they are in, but readily and easily quit them. Whereas *Hard Bodies* rest, and according to the *Law* of *Natures* immutability, strive to continue in the state of *Conjunction*, except they be disturbed by some strong *Motion*.

X.
How the
Parts of
Solid Bo-
dies are
joyned to-
gether.

This Sentiment will not please some *Philosophers*, who suppose no two *Bodies* can be joyned without some intervening *Third*, distinct from them both; which they imagine to be as the *Glew* that holds the parts together, that the *Union* may be the more firm: But since nothing is to be admitted in *Natural Philosophy*, which we are not convinc'd of by *Reason*, we must consider first, what kind of *Glew* this can be, before we appropriate it to this use. Without doubt it must be either a *Substance*, or the *Mode* of a *Substance*, seeing that amongst *Natural things* nothing else is to be found besides *Substances* and their *Affections*. If it be supposed to be a *Substance*, it cannot be understood why the *Parts*, which because they are *Substances*, cannot be united by themselves, should yet stand in need of an adventitious *Substance* to unite them. If it be a *Mode*, then without doubt none can be more properly assign'd to this purpose than *Rest*, since that which makes the *Parts* to be united together, must be most oppos'd to *Motion*, by which they are divided from one another. For *opposit Things must have opposit Principles*; but nothing is more contrary to *Motion* than *Rest*, as being the contrary *Affections* of *Material Substances*.

XI.
The Motion
of the
Particles
of Fluid
Bodies, is
discernible
from their
Effects.

You'll say, *How may we know that the Parts of Fluid Bodies are in continual Motion?* I answer, That tho' the smallness of those *Particles* doth not permit us to discern their *Agitation*, yet may the same be easily discovered by the *Effects*. There is no body but perceives, that some parts of *Water*, evaporate in *boiling*, and that in the *Summer* time *Ponds* are less'n'd or dry'd up, which could not be, but that some *Parts* of the *Water*, being separated from one another by *Motion*, steam away into the *Air*. Moreover, how else comes it to pass that the *Particles* of *Water*, do so readily mix together? Or, how could they insinuate themselves into the *Pores* of *thick Bodies*, if their *Parts* did cling together by natural *Rest*?

XII.
The Motion
of Parts
causeth
their Di-
vision.

For the *Division* of *Parts* depends on their *Motion*, *Agitation* being that which separates one thing from another. This is very evident in *Flesh*, which is soon corrupted by the *Air*, the *Particles* wherof being agitated either by the *Sun*, or some other way, thrust themselves into the *Pores* of *Flesh*, and by dilating of them and spoiling their Natural situation, do at last dissolve and putrifie it. The ready and thorough mingling of *Liquors* discovers the same thing, it being evident that this

easy mingling cannot be done without *Motion*, whereby the *Parts* of two *Liquors*, as for Example, *Water* and *Wine*, run together.

Besides, what *diversity* would there be amongst *Bodies*, if all their *Parts* lay still together, and were equally united? *Cold water* would not differ from *Ice*; *Crystal* and *Milk* would be the same thing; nor would any Cause be assignable, why *Crystal* resists our touch, or why *Milk* yields to the approach of *Hard Bodies*.

Wherefore we may conceive twofold *Parts* in *Liquid Bodies*; some at it were *flying*, by reason of their swiftness, such as the *Parts* of *Smoke*, the *Steam* of *boiling Water*, and *Flame* are, which are so forceably that our *Senses* can discern their *motion*: And others, as it were, *creeping*, because of the slowness of their *motion*; as the *Particles* of *Oil*, *Milk* and *Wine*, whose *motion* is so slow and leisurely, that our *Senses* cannot perceive it. So that when it happens that one *Liquid Body* is not sufficient to dissolve another, or that it can exercise its force more upon one *Body* than another; the Reason thereof chiefly is, because its *Parts* are more or less agitated, or because the *Pores* of those *Bodies* are not open alike.

Soft Bodies approach to the Nature of *Liquid*, and are such whose *Particles* do not cling so close and firmly together, as the *Parts* of *Hard Bodies*, nor are agitated with so swift a *motion* as *Fluid Bodies*, but partake of both their *Natures*, being middle things between *fluid* and *stable Bodies*, such as are *Sand*, *Wax*, &c. The softness of *Sand* is caused, for that something intervenes betwixt their separated *Parts*: And *Wax* is soft, because its *Particles* terminate in flexible branches, which twisting together lightly, joyn the said *Parts*.

Of *Hard Bodies* some are *Frangible*, others *Friable*. For whatsoever can be broken must have such a degree of stiffness, that its outward *Parts* when struck, may be neither dilated, nor admit any ingress of *parts* into *parts*; but that the *surfaces* being broken, the *inward parts* likewise be divided and broken asunder. Of which Nature are *Flints*, *Earthen Pots*, *Stones*, and the like, which according to the diversity of their contexture, are more easily or hardly broken.

Thus *Friable Bodies* must have so much stiffness, that they cannot be stretched or bended; but upon any force pressing upon them, do crumble into *Dust*. Of which Nature is the *Sand-stone*, which is easily dissipated into small *parts*, and those again easily crumbled to *Dust*.

Amongst *Soft Bodies* are reckoned those that are commonly called *Ductil* (that is, *Bodies* that suffer Drawing or Extension) such as *Gold* is, one *grain* wherof may be drawn into a *Thread* of four hundred Foot long; and consequently one *Ounce* to the length of 230400 Foot. The Cause of which vast discussion is commonly attributed to its extream *Compactness*, the *Thinness* of its *Parts*, and their intimate *Union* and *Connexion*. Of which we shall speak more at large hereafter.

Some reckon *Bodies* that may be cut or slit, also amongst *Soft Bodies*; because whatsoever is cut, must have so much flexibility, that the *Part* which is prest (suppose with an *Axe*) can give way downwards, at the same time that the *Collateral parts* yield to the dividing *Instrument*. And whatsoever can be slit, must be so flexible or bending, that

XIII.
Bodies
would not
be distin-
guish'd
from one
another,
if some
were not
moved.
XIV.
Parts of a
twofold
sort are
found in
Liquid
Bodies.

XV.
What Soft
Bodies are.

XVI.
Frangible
are rec-
kon'd a-
mongst
Hard Bo-
dies.

XVII.
Friable
Bodies.

XVIII.
Ductil Bo-
dies resort
under Soft
Bodies.

XIX.
Bodies that
may be cut
or slit, be-
long to Soft
Bodies.

that when the *Parts* in a certain place, begin to be pull'd asunder, a Compression may be successively made, in whatsoever places the rest are to be gradually separated from each other. *Wood* is said to be Cut, when it is divided *Cross-wise*; but to be slit, when divided *Long-ways*, or with the *Grain*.

CHAP. XXII.

What Loose and Close, Rough and Smooth, Contiguous and Continuous Bodies are.

AS *Stable* and *Fluid Bodies* are constituted such by *Rest* and *Motion*; so *Loose* and *Close Bodies* are made such by their *Figure* and *Situation*, not outward, but inward. For the *Looseness* or *Closeness* of *Bodies*, is not to be considered according to the outward Space in which *Bodies* are dilated or contracted; seeing that a *Body*, whose *Essence* consists in three *Dimensions*, cannot take up a greater Space at one time, than at another; but according to the *Intervals* which are understood to be betwixt their *Parts*; and which are said to be *distended*, when they are fill'd with any foreign Matter; or to be *contracted*, when by Removal of that Matter, they are either lessened, or quite taken away.

For we must not imagin, as many do, that the parts of *Loose Bodies* are so separated from one another, that nothing extended comes between them; For no such *Vacuum* can be in *Nature*; but that the said *Intervals* are fill'd with other *Bodies*; as is apparent in *New-bak'd Bread*, which being put into *Milk* or *Vine*, presently swells up into a much greater bulk; because the Pores of the Bread are distended by the intruding particles of the *Vine* or *Milk*. So that all the New Extension we find here, is not to be attributed to the Substance of the Bread, but to the fluid Body that hath insinuated it self into the pores of it. Which is evident not only to Reason, but to the Senses themselves: For if a man behold the Steam that riseth out of a Pot of boiling Water, or the Smoke that proceeds from a Torch at a distance, he will suppose the parts of them to be contiguous; but when he comes nearer, and views them more wishly, he will find that there is neither Continuity nor Contiguity between the parts of them, but that they are separate from one another, by means of a foreign intervening Matter that divides them.

A Body becomes close, when the parts of it being nearer together, leave few Intervals, or none at all. Of the first sort are *Snow*, *Hay*, and *Wool*, when they are compress'd, as also a *Sponge*, when the Water is squeeze'd out of it; for then by the expulsion of the Liquor, its Pores are narrowed, and few Intervals are left in it, to receive any outward Bodies. Of the latter sort are those Bodies, which have no Pores at all into which any External Body can enter; and when it is so close, then it cannot be further condensed by any Power of Nature.

As with respect to the Figure and Situation of its Inward parts, a Body is distinguish'd into Loose and Close; so with regard to their Outward figure and situation, Bodies are said to be Rough or Smooth. Which Modes are of great efficacy in Natural things; as appears in a Knife, wherewith the Hardest Bodies are cut; and in a Pen, with which an infinite variety of Characters may be made.

Rough Bodies are such whose superficial Parts are unequally disposed, so as that some are prominent and others depressed; as *Rusty Iron*. But *Smooth* or *Polish'd Bodies* are such, whose Extream parts are equally situated, as *Ice*, a *Whetstone*, &c. *Smooth Bodies*, because of their Surface, have more force to Act or Resist, than *Rough Bodies*. For a *Sword*, whose Edge and Extream parts are polish'd and even, cuts deeper than another *Sword* of the same bigness that is *Rusty*; and a *Ball* rebounds more strongly from polish'd Bodies, than from rough.

Yet we are not to imagin, that all those Bodies in which neither our Touch nor Eyes can discover any inequality, are altogether smooth; forasmuch as even *Glass* and *Crystal*, which appears very smooth, have a rough Surface. For tho' Glass be made of *Salts*, which by Melting are resolved into very small Particles; yet because those Particles still retain their former figure, they can never make a polish'd Surface. What appears to our Eye more smooth than Paper? And yet by the help of a *Magnifying-Glass*, we perceive it to be very rough and uneven. Hence it is manifest, that in what part soever of the Medium the Eye be placed, it receives the various Rays, which come from and represent the Object.

The two Remaining Species of Bodies are *Continuous* and *Contiguous*. A Body is said to be *Contiguous* with respect to the situation it hath amongst other ambient Bodies. Thus a *Tree* surrounded by the *Air*, is said to be *Contiguous* to it. And accordingly a *Contiguous Body* is thus defin'd by *Plato* in *Parmenides*: That which is to touch something, plac'd by it self, must be next to that which is to be touch'd; neither is there any Third thing that is a Medium between both these. A *Continuous Body* is that which besides the situation it keeps amongst *Circum-ambient Bodies*, becomes united to them, and by Rest is joyned with them. Thus a *Stone* is said to be a *Continuous Body*, being considered whole and undivided, and before any change happen to it by Motion. But this Contiguity of Bodies is not in all their parts, but only in those that are Insensible, since such only have an immediate Contact with one another.

The Continuity therefore of Bodies consists in this, that their parts do cleave together by an Immediate Connexion, and rest together. So that *Continuous Bodies* cannot be dissolved, but by such a Motion as prevails over the Rest of their Parts. The Contiguity of Bodies consists in this, that their Extream parts lying still together, nearly touch one another, yet so as that a most thin subtil Matter flows and runs between them; and by reason of this Interfluent Subtil Matter, the parts of *Contiguous Bodies* are more easily separable.

CHAP. XXIII.

That there are Pores in Hard Bodies, as well as in those that are Fluid and Soft.

THO' it is not denied, but that the World was Created in the Beginning with all that Order and Beauty which we find it to have at present, and that all the Bodies contained in it had the same perfection which we see they now have;

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†. All Bodies are not Smooth, which appear to be so.

VI. What a Contiguous and Continuous Body is.

VII. Wherein the Nature of Contiguity and Continuity consists.

I. Supposing Bodies to be moved, it is necessary that there be

I. Whence proceeds the Looseness or Closeness of Bodies.

II. Loose Bodies are made such, by the ingress of Matter; Close Bodies by the Egress.

III. Examples of Loose and Close Bodies.

IV. What Rough and Smooth Bodies are.

Intervals
or Passages
left between
them.

yet in order to our more accurate understanding of the State of Bodies, it will be of use at first to consider all Matter as one undivided Lump or Mass, and afterwards conceive the same distinguish'd into parts, by the Motion impress'd upon it by God, out of which Parts all Bodies are made. For by making this Supposition, the Constitution of Bodies is the better conceived; and the Connection between the several Parts, will the more plainly appear. For these Particles having obtain'd various Figures by means of Motion, it was not possible for them to be so united together, as that no Intervals should be left between them, to be fill'd by some other Subtil Matter. These Intervals we call Pores, which do arise from the various Conjunction of little Bodies or Particles.

II.
How Pores
come to be.

First, When the parts that stick together are Round; for since these, by reason of their Convex sides, can only touch each other in a point, they must necessarily leave little Intervals between them. In the Second place, when those parts have irregular Figures; for then by reason of their various Termination, they cannot so intimately close together, but that some little Spaces must be left between them. Thirdly, By the Force of the Subtil Matter, which being excessively Active, by separating joyned Bodies, makes way for it self to penetrate them. Which Irruption of the Subtil Matter is very frequent in Soft and Fluid Bodies; because, as hath been said, they give easie admittance to other Bodies, and by their Motion do assist their Impulse. Hence it is that the Fluid Matter, which consists of Round particles, is accounted the most Porous: For tho' little Globular Bodies are very proper to compose a Liquid Body; yet because of their Figure, it is necessary that Triangular Spaces be left between them, not empty, but fill'd with the Matter of the First Element. Thus we see, that the Light of the Sun does come to us, through the Spots with which it is surrounded; which could never be, but that they abound with Pores, which afford passage to the Matter of the First Element.

III.
How Pores
are come
to be in
the Spots
that are
about the
Sun.

These Pores are easily conceived to have been made at the first beginning of their Generation, viz. when the Matter of those Spots was as yet very Loose and Soft; and when afterwards it became more Close and Compact, the particles of the First Element, by passing through them continually, kept them from being quite closed; tho' they were so far narrowed, as to admit only that Subtil Matter.

IV.
If there
were no
Pores, there
could be no
distinction
between
Bodies.

And the same Reasons prove, that there must be Pores in all other Bodies, except those only whose parts do so intimately touch one another, that they can be no further compress'd or condensed; for such as these are the hardest Bodies of all, as being devoid of all Pores whatsoever. But should we suppose this to be the condition of all Consistent Bodies, we should by this means take away all distinction that is between them; as for Example, between Wood and Stone, between Crystal and Earth; since between them there would be no distinction, as to their Inward Figure and Situation, and consequently all Bodies, as to their Inward parts, would be alike; which is the same as to say, that all Bodies are Close, and that none of them are dilated by admittance of the Subtil Element.

But since the Difference of Bodies is apparent to the very Eye, some of them being Living Bodies, other Lifeless; some Transparent, others Dark; it is necessary that there be a difference between them with respect to their Inward parts. For if we deprive Hard Bodies of their Pores, we shall never be able to understand how Plants are nourished and grow, since this cannot be without the receiving of Juices, whereby their Parts become dilated and extended. For according to the diverse disposition of the Pores of Trees, their Growth and Nourishment is also different. Thus we see that an Oak and a Medlar Tree, with other such like Plants, because of the Hardness of their Sides, and the narrowness of their Pores, do grow more slowly; whereas a Vine, a Gourd, and other such like, whose Pores are wider, grow very swiftly and spread their Branches far and near.

That this is so, is evident in the Winter; for then all Budding and Growth is hindred, because the Pores at that time, by the Sun's departure, being closed by Cold, cannot admit their Food, as they were wont.

The Existence of Pores is prov'd likewise by that Experiment which was made in presence of the Great Duke of Florence, which was as follows: A Glass Vial, with a long and narrow Neck, was put into warm Water, almost up to the middle of the Neck; after a small time the Liquor contain'd in the Vial seem'd to fall down a little; but to rise again to its former height, when the said Vial was put into cold Water. Because the Pores of the Glass being enlarged by Heat, procure it a greater Capacity; whereas, when the Pores are straitned by the cold Water, the capacity of the Glass grows less, which is the cause of the Rising of the Liquor.

Moreover, we daily experience, that a Bow when unbent returns to its former figure, which Return cannot be attributed to any Cause, save only to the bending of the Pores. For the Subtil Matter which was us'd to pass through those Pores, now by reason of the bent of it, is not able to pass through them with the same ease, and therefore endeavours to reduce them to their former figure. Which may be done several ways. For if, First, we suppose that the Pores of the unbent Bow, in their Natural posture, are of the same wideness at their entrance and ending; but that when bent they become more narrow at the end, it cannot be doubted but that the Subtil Matter, which enters the wider parts of them, will put a force upon the more narrow parts, and thereby cause the Bow to fly back. Secondly, If we conceive the said Pores of the Bow, before Inflection, to have been Round; and that by the bending they became Elliptical, the Subtil Matter that is to run through them being Round also, it is evident that whilst they endeavour to enter those Elliptical Cavities, they strive to reduce them to their Spherical Figure; which is the Cause why the Bow flies back to its first state.

But to return from this particular Example, to the consideration of Pores in general; we say, that all Bodies that have like Pores, are like to one another, if withal they agree in the same Quantity, Motion, Rest, Figure and Situation of Parts. For diverse Matter requires diverse Pores, seeing it is necessary for it to be differently constituted as to its little

V.
There are
many Bo-
dies that
cannot be
without
Pores.

VI.
Without
Pores we
cannot
understand
the Growth
of Trees.

VII.
The Pores
of Bodies
prov'd by
an Experi-
ment.

VIII.
How a bent
Bow, as soon
as unbent,
returns to
its former
straightness
again.

IX.
The Like-
ness and
Unlikeness
of Bodies
proceeds
from their
Pores.

little Particles, to the end it may be able to exert its Force, and to thrust it self into other Bodies. But yet we are not to imagin, that all the Pores of Consistent Bodies, have their Pores hollowed after the same manner, or disposed in the same situation and figure: For they who in Winter time put on a Wastcoat over their Shifts, find themselves less subject to Cold, than when they wore nothing besides their Shirts; which would not be so, if the Pores of the Shirt and Wastcoat did answer to one another in their figure and situation.

X
How the Pores of Bodies come to be destroyed.

As Pores do arise by the Generation of Bodies, so by their Dissolution they are destroy'd. Thus the Pores are destroy'd in Wood that is worm-eaten, and in Clothes that are Moth-eaten. Or if the Pores be wider, as in woollen Cloth, and other such like, they may happen to be divided in the midst, and afterwards be made whole again by being joyn'd to other Pores of a like figure. Another way whereby Pores are destroyed, is that of Obstruction, when the parts of Bodies become so closely united, as to make one Continuous Body; as when by means of Condensation the Pores are lessened, or quite taken away; or when some supervening Matter remains in them, and hinders any other Matter from entering them: So when the Pores of the Sails of a Ship are fill'd with Water, it hinders the Wind from passing through them, notwithstanding that the Wind have a far greater agitation than the Water.

CHAP. XXIV.

Concerning Duration, and its Species, Time and Eternity.

I.
Duration agrees to all existing Beings, and is only notionally distinct from them.

FORASMUCH as Natural things exist, and take up certain places, it cannot be doubted, but that they are Sometime, and that they have Duration and Continuance in their Existing. For Duration is the Consequent of Existence; and whatsoever is not made, and destroyed in the same moment, must be considered as enduring, so that Duration may be defined, An Attribute under which the Existence of Created things is conceived, in as much as they persevere in their Actuality. From whence it is evident, that Duration is not really distinct from the Existence of a thing, there being only a Notional distinction between them. Because as there is no Body so little, but that it doth consist of parts, and may be measured with three Dimensions; so there is nothing in Nature of so short a Duration, but that we can measure it; neither can any thing be taken from its Duration, but as much must be taken from its Existence.

II.
The Definition of time

Time therefore is nothing else but the Measure of the successive Duration of Bodies, according to the equal Motion of the greatest Bodies, viz. the Sun, Moon, &c. Aristotle defines Time to be the number of Motion, according to Former and Latter. But this Definition stands in need of another to make it Intelligible, except by the number of Motion according to Former and Latter, he means only thus much, that by Time we number the successive Duration of Bodies, in which there is Former and Latter according to the Motion of the Sun.

III.
The three Differences of time.

There are commonly three Differences of Time reckoned, viz. Past, which hath already been; Present, that which now is; and Future, that which shall be. By the Present time, we are not to under-

stand an Indivisible Instant; for no such can be found either in Time or Motion, the Nature of them both being successive; but all that part of Time, which the Mind represents to it self as Present: Thus we say, the Present Hour, Day, Month, &c.

From the fore said Definition of Time, it is apparent, that Time, being the Measure of the successive Duration of Bodies, must Measure Rest, as well as Motion. For we say as commonly, that a thing hath rested, as that it hath moved so long. The same is manifest also from this Example, If a Dog, in half an hours time, run three Miles, and a Tortoise in the same time go only the length of one Pace; the Measure of the Time will be the same in both these motions, when yet there is much more motion in the Dog, than in the Tortoise. And therefore Time is nothing else, but the Duration of a Creature in whatsoever State it may be.

For we find Succession in every Created Being, and we can Measure the same by motion properly so called, or at least by the thoughts of our Mind, which seeing they do not exist all at once, must needs involve Succession. Wherefore, neither can the Duration of an Angel or the Mind of man, be said to be altogether at once, as the Duration of God is, because we clearly understand succession, both in our own thoughts, and those of an Angel; for Angels do not think all things together and at once. But such a Succession cannot be admitted in the Divine thoughts, God being an Act altogether Simple, Complete, and liable to no Vicissitude. Wherefore also Gods Eternity is his very Nature and Essence, forasmuch as he is most sufficiently of himself. And so Time is the same with the Created things themselves, forasmuch as they receive their finite perfections successively, that is, the one before the other.

You'll say, suppose a Creature should only continue one Moment, that thing would exist in the World, but without any Succession of Existence; therefore Succession is not involved in the conception of Duration.

I answer, that Duration cannot be understood without Continuation, and therefore no part of Duration can be assigned so small, but that there must be continuance in it: Since no Moment can be conceived, which is not divisible into other Moments. Wherefore those are mistaken, that make the present Time, to be an Indivisible; for since every Duration is Greater or Less, that is, consists of more or less Parts, no real Particle of it can be assigned, which hath not a quantity of its Duration distinct from another. Wherefore as every Particle of a Body, may be divided into other Parts: So likewise the present Time is compounded of Parts, and is divisible into other Moments.

Whence it follows, that Time is not an Affection of Created things, but a mere Mode of Thinking, or an External Denomination, which we call an Entity of Reason. For as Things, from the the Operations of our Mind, are said to be Known, Understood, Defined, &c. of which Operations they are only the Objects; so Time, whereby we Measure the Existence of Created things, is no more with regard to them, but an Extrinsecal Denomination, and a Mode of Thinking, made use of for the explaining of Duration. Hence L U C R E T I U S sixth Book I.

IV.
Time is the Measure as well of Rest as of Motion.

V.
Succession is included in every Duration.

VI.
An objection taken from a thing that exists only one Moment.

VII.
The answer that all Moments are divisible.

VIII.
Time is only an Entity of Reason.

Time

Time of it self is nothing, but from Thought Receives its Rise, by labouring Fancy wrought From things consider'd, whilst we think on some As Present, some as Past, or yet to come. No thought can think on Time, that's still confest,

But thinks on things in Motion or at Rest:

GASSENDUS from these Verses of LUCRETIUS, concludes EPICURUS to have been of the Opinion of ANTIPHANES, who held, that *Time was something that had no real Existence, but only in the thought of Man.* which ARISTOTLE also seems to insinuate, whilst he defines *Time* by *Number*, which cannot exist without the understanding of the Counter or Numerator. *It is not in vain*, saith GASSENDUS, that EPICURUS warns us, that we are to speak otherwise of *Time*, than of other things, which are in a Subject; thereby intimating to us, that *time is in a Subject only by the help of our thoughts*; forasmuch as the *Mind of Man* considers a thing not to cease to be, at the same moment it begins to be, but to abide and continue, and to keep its Existence for a longer or shorter space of time. So that that it is evident that EPICURUS would not have any thing further to be inquired of *Time*; than what the *Mind* at first sight conceives of it, that is, a stay or continuance, whether it be longer or shorter. And if any Man should demand what *Time* is, we may answer him with DEMOCRIUS, that *Time is just such a thing, as is the space of Day and Night.*

IX.
What Duration is called Time.

Wherefore to the end we may Measure the Duration of all things, we compare it with the Duration of some particular Beings, which have a certain and most equal Motion, by which Days and Years are made, and this Duration we call Time. Wherefore they who suppose the Sun to be whirled about the Earth, or the Earth to turn round about its own Axis, attribute time to the motion of either of them, as being its proper Measure, according to Former and Latter: But as for the Duration of other things, they will have them to be measured by time, only by means of an external Application of our Mind. Thus when we say, that Nestor lived 300 years, we mean that he lived so long, as that Motion lasted, wherein the Sun performed 300 of its yearly Courses, or the Earth 1095 Circuits about its own Axis.

X.
How time is said to flow, or to be successive.

If any one urge, that that there are many things agreeing to time, which cannot be attributed to an Entity of Reason or an Extrinsic Denomination, as when we say, that *Time flies*, *Time teacheth Men many things*, that *Time comes*, follows, &c. which cannot be spoke of a thing that doth not exist at all, but only depends on our thoughts.

XI.
Answer.

I answer, that these are Metaphorical Speeches, and which agree only to the things that pass away, are taught, come, follow, &c. For Time is said to run, or pass away, when things by an outward Application of our Mind, with respect to the motion of the greatest Bodies, which can be observed by all Men, are understood to exist for some time. Time is said to teach all things, when those things which heretofore were hidden from Men, come to be known; and upon the same account, Time is said to come, to succeed, to vanish, &c.

If any Man should infer from hence, that therefore upon the ceasing of this universal and equal motion, of the Sun or Earth; Time must cease also, and be no more, because then our Mind will be no longer able to compare the Duration of Created things, with the Duration of certain equal and stable motions.

To this I answer, by denying the Consequence, because Former and Latter is not only in motion, but also in our Thinking Mind, since that in it we find a true succession of Thoughts; for we cannot at once and altogether Think of all things, we can think of. And therefore, tho' all motion should be taken out of the World, yet would not that put an end to succession, but Created things existing in our Thoughts, would be still commensurate to Former and Latter.

Having thus explained the Nature of Time, it remains that we speak a few words of the other species of Duration, viz. Eternity, which they call the Duration of a thing, without either Beginning or End, and which belongs to God alone. And which BOETHIUS defines to be, *The All at once, and perfect Possession of an Interminable Life.* The word Life, is here taken for the existence of a thing, endued with all the Perfections it is capable of. The words all at once intimate, that Perfection does not agree to the Eternal Being successively, but that he possesseth them all at the same time. Whence we may infer, that no Creatures, whether Material or Incorporeal, could ever be Eternal, because it implies a contradiction for them to possess at once all the Perfections, Qualities and Modes which they are capable of.

From all that hath been said it appears, that there are some things whose Essential Parts, can exist together, or all at once; and that there are others to whom this cannot agree. The better to distinguish these, I call those things successive, whose Essential Parts are in a continual Flowing. Thus Time is a successive Being, because Present, Past and to come, which are the Essential parts of it, are never all at once. And I call those Permanent, all whose Essential parts are together. Thus a Triangle is a Permanent Being, because the Content and the three Sides, of which it is composed, do exist all at once, or at the same time.

CHAP. XXV.

The Ends of GOD are not to be enquired after in Natural Philosophy.

THO we own GOD to be the Efficient Cause of all things, and that all Creatures depend on him alone, yet we have no mind to enquire, for what end they were produced by God, and what Reasons he propounded to himself, in calling them out of the Abyss of Nothing. Who knows not that the Secrets of God are unsearchable, and past finding out? And as it is not the part of an Earthen Vessel, to dispute the Point with the Potter, why he hath made him such; so neither does it become Mortal Man, to question with his Maker, why he hath done so and so. And indeed this Reason alone taken from the Divine Majesty, and our Littleness and Meanness, may be sufficient to restrain us, from enquiring into the Ends God hath proposed to himself in the making of Natural things.

XII.
Whether upon the ceasing of the motion of the great Heavenly Bodies time ceaseth also.

XIII.
Answer.

XIV.
What Eternity is.

XV.
All Beings are either Permanent or Successive.

I.
It is a piece of Reason to enquire concerning the ends of God.

For

II.
Our Human
Infirmary
ought to
restrain us
from enqui-
ring into
the Divine
Secrets.

For tho' in the Contemplation of *Natural things*, it be permitted to us to enquire, from what *Principle* they proceed, what their *Matter* is, and with what *Forms* they are perfected; yet is it a piece of *Rashness* and *Arrogance* in us, to dive into *Gods Counsels*: Whereas we ought rather to consider that we are weak *Creatures*, of limited *Perfections*, and not fully *Masters* of our own *Actions*; whereas *God* on the other hand is *Immense*, *Infinite*, *All-wise* and *Omnipotent*, so as to be able to produce innumerable *things*, the *Reason* whereof could never enter into our *Thoughts*.

III.
The things
which are
done in the
Earth are
not known.

For if we are not able to give an account, of what use those *things* are to us, which in such great abundance are hid in our *Earth*, and cannot assert but that they have been destinated by their *Author*, to ends altogether unknown to us: How then shall we dare to pry into the *Arcana* of our most *Good*, most *Powerful* and most *Glorious* *Creator*? As if we were familiarly acquainted with his *Mind*, and as if we had been his *Privy Counsellors*. Is it not much better for us to adore his *Goodness*, without determining of those *things*, which it is not allowed *Man* to *know*, nor permitted to *search* into.

IV.
The Divine
ends in
Moral
things may
be searched
after, but
not in
Natural
things.

I own that in *Moral things*, where *Conjectures* are of more *Authority*, it may be conducive to *Piety*, to enquire into, and determine the end *God* hath proposed to himself in *Creating the World*. Therefore *Preachers* to excite the *Divine Love* in us, set before our *Eyes* the several uses and advantages, which the *Creatures* afford us, telling us that they were made for our *Sakes*. But in *Natural Philosophy*, where nothing is to be admitted, which is not built upon the most unshaken *Reasons* and *Arguments*, it seems to be a foolish thing to guess at any end, that *God* should have proposed to himself, in the *Creation* of the *World*.

V.
Objection,
that all
things were
made for
Mans sake.

But some will tell us, that according to the *Scripture*, all things were made for our *Sake*, because they are of some use to us. And therefore say, that the *Sun* was *Created* to give us *Light*; that the *Soul* of *Man* was made by *God*, to Contemplate him; yea, that the whole *Universe* was *Created* for *Mans Sake*, seeing that all *Creatures*, are some way or other serviceable to him: And that *Consequently Gods ends* may be known by us, as well as any other *Causes*.

VI.
The First
Answer.

To this may be answered, *First*, That true indeed it is, that the six days of the *Creation* are so described in *Genesis*, as that *Man* seems to be the chief end of them: But it may be said, that this *History of Genesis*, was penn'd for *Man's Sake*, and that therefore the *Holy Spirit* was pleased chiefly to set down those particulars which have reference to *Man*.

VII.
The Second
Answer.

I answer *Secondly*, That it doth not appear at all, that all things were *Created* for the *Sake* of *Men*. For how do we know, *what* and *how*

many things, *God* hath made besides this *Earth* which we *Inhabit*, in the *Stars* and elsewhere? How do we know, but that there may be other *Creatures*, specifically distinct from any of those which we see, other *Animals*, other *Men*, or at least *Creatures Analogous* to *Men*, in some other places? These things are unknown to us poor *Mortals*, because the *Divine ends* and *Counsels* are hid from us. When it is said therefore, that all things are *Created* for *Man's sake*, we are not so to understand this, as if they had no other use, save what they render to *Mankind*; but only this, that *Man* can and must exercise his *Wis* and *Understanding* about them. Now it is a quite different thing to say, that *Man* was *Created*, that he might *Celebrate* and *praise God* for the excellence of his *Works*; and to assert that all these *things* were *Created* for *Mans sake* alone. For in the former, *Mans Duty* is intimated, but in the latter, the end and aim of the *Creator* in making the *World* is determined.

Besides, it is an absurd thing to imagin, the *Sun* to have been *Created* for no other end, save only to enlighten us: And that the *Stars* and *Plantes* were ranged in their several *Vortices*, only to assist and pleasure us; since we are the very least part of the *Earth*, and the very *Earth* it self (in respect of the *Heavens*) is no more than a small *Grain of Sand*, compared with a *Mountain*. Wherefore let us take heed of entertaining such presumptuous *Thoughts* of our *selves*, as if all things were made for our *use*, *profit* and *advantage* only; when there may be an infinite number of *Creatures*, that by many degrees exceed us, whose *Nature* and *Excellence* is altogether hid from us. Have not we much more reason to have such *thoughts* as these, than to entertain those other presumptions, when we consider the immense *Power* and *Wisdom* of our *Infinite Creator*?

VII.
It seems a
great piece
of Rashness
to assert
that all
things were
created for
Mans sake.

Some, pretending *Zeal* for the *Honour* of *God*, tell us, that his own *Glory* was the end and aim he proposed to himself, in the *Creation* of this *Universe*; as if *Gods* aim in the *Production* of this *World*, had been only to display his *Magnificence*, and to exalt his own *Glory*. But who can believe this? Shall we say, that *God* could not have provided for his own *Glory*, by other things different from these? Would his *Honour* have been ever the less, if he had *Created* another *World*? You must then own, that his *Glory* was not the sole motive he proposed to himself in creating of the *World*. Moreover, how can it be said, that *Glory* was the *Creators end*, seeing it is a thing extraneous to him, and which doth not at all belong to his *Essence*? For *God* can never be said to be determin'd in his *Actions*, by any thing that is without him, neither can any *thing* that is without him, be a motive to him.

IX.
The Glory
of God
was not
the Reason
why the
World was
created.

The Fifth Part
OF THE
INSTITUTION
OF
PHILOSOPHY.
VIZ.
SPECIAL
Natural Philosophy,
CONCERNING THE
WORLD
AND
HEAVEN.

CHAP. I.

Of the Unity and Perfection of the World.

I.
What is
meant by
Special
Physicks.

HAving examin'd those things that belong to GENERAL PHYSICKS, and thereby consider'd a Body or Matter in General; that is, its Nature, Principles, General Affections and Differences; we proceed now to SPECIAL PHYSICKS, or that Part of Natural Philosophy which takes a view of Matter, as distinguish'd into Species, and lays open their several Species, Properties, Distinctions, and Mutations, in a more particular manner.

II.
The Species
of Bodies
may be
considered
two ways.

Now the Species of Bodies may be consider'd after a twofold manner, viz. either jointly or Separately; or, as others express it, Collectively or Distributively. The Species of Bodies are Collectively consider'd, when they are view'd all together, as the Parts that constitute one Whole or Entire Being. Distributively, when the chiefest Species of Bodies that compose the World, are in a convenient Order particularly examined.

III.
The Definition
of the
World.

The whole which contains all the Species of Bodies, is called the World; and is the Comprehension of all Natural Bodies Created of GOD, and for GOD, by the most free Motion of his Will

most beautifully Adorned, and most wisely Governed, and powerfully Preserved. And is thus defin'd by ARISTOTLE; *The Structure of Heaven and Earth, and of the several Natures comprehended in them.* Lib. de Mund. Cap. 2.

For the WORLD comprehends all and every thing that can fall under our Thought. Whatsoever Rhetorick commends, or Philosophy admires, is a part of it. And therefore the Ancients have told us, That the World consists not only of Animals and Men, but of Gods also; and that accordingly the World is a Kingdom or Commonwealth, compos'd of the Gods, Men, and Animals: Which Saying of theirs is true enough, save only in that it imparts the Name of God to many, which is due to none but One alone.

The WORLD is but One only, neither can a Plurality of Worlds be conceived without a Contradiction; for there can be no more than one Universal comprehension of Bodies, seeing that many Worlds cannot be conceived without Distance, neither can Distance be without Extension, nor that without a Body, which mediating Body would then joyn both Worlds together; for the conjunction of the Parts of the World consists in nothing else but this, that all the Bodies in it touch one another. But to imagin two Worlds separated by a Vacuum or Imaginary Space, that is,

IV.
The World
contains
all things.

V.
There is
but One
World, and
no more.





two Bodies distanced from each other by Nothing, is meer Folly; because to this distance by Nothing would belong *Extension*, *Divisibility*, and *Mensurability*, and it might be either nearer or farther off.

VI.
Plurality
of Worlds
implies a
Contradiction.

However, if any one should question, whether there may not be another *World* distinct from this. My Answer in short is, that they who hold a Plurality of *Worlds* not to imply a Contradiction, say, that supposing there were a *World* distinct from this we live in, it might be placed in that Space which we imagine to be beyond the utmost *Heavenly Sphere*; but it is impossible that any Bodies should be there, seeing it is supposed to be *Nothing*, or something *Imaginary* only, and which consequently can have neither *Parts* nor *Effects*, and therefore cannot place any thing. For *Place* being nothing else, according to *Aristotle*, but the *Surface of the ambient Body*, how shall we find a place there, where no Bodies, nor *Surfaces* are to be found?

VII.
Many
Worlds
cannot be
united to-
gether.

Moreover, if beyond the *highest Heaven*, there should be another *World* like to this, either they would touch one another, or be separate. If we suppose them separate, there must be some *Medium* that may wholly surround them both, and so neither of these *Worlds* would be utmost, as having still something beyond them; and if they touched one another, being *Round Bodies*, there must be a *Vacuum* left between those parts, that did not touch; but we have proved a *Vacuum* to be an Impossibility in *Nature*, in our *General Physiology*. Besides, the *Space* which we imagine to be betwixt these two *Worlds*, is not a meer *Nothing*, but a *Body*, since nothing but a *Body* can make a *Distance* betwixt two *Bodies*: For we cannot conceive one thing to be distant from another, without some real *Medium* that separates them, which seeing it can be nothing else but a *Body*, it will joyn both *Worlds* together, and so instead of separating these two *Worlds*, it will unite and make but one of them.

VIII.
Whatsoever
we imagine
to be Ex-
tended, is
a Body.

But to put an end to this Dispute, we say that this *World* hath no Bounds of its *Magnitude*. For seeing every *Space* is something extended, and that no *Extension* can be without a *Body*, we conclude that nothing can be conceived by us beyond the *Heavens*, but what must be *Real*; and consequently that there can be no other *World* besides this. And yet it cannot be infer'd hence, that the *World* is *Infinite*, but only that it is *Indefinitely Extended*, because we cannot conceive so great an *Extension* in the *World*, but we may still imagine Greater, forasmuch as all imaginable *Spaces* are fill'd with *Matter*.

IX.
The World
is not Infi-
nite, but
Indefinitely
extended.

You'll say, If the *World* be *Indefinite*, that is, if we can imagine no Bounds or Ends of its *Extension*, it must be *Infinite*, because *Infinite* is nothing else, but that which hath no End.

X.
The first
Answer.

I answer, *First*, All grant that there are *Indefinite Parts* in every *Body*, so that it is impossible to come to the last of them; and yet no body ever asserted, that therefore a *Body* was *Infinite*. So tho' we admit an *Extension* in the *World*, the end whereof we cannot imagine, yet is not the *World* therefore to be reputed *Infinite*. For I do not see how that which hath *Finite Parts* can be accounted *Infinite*; nor how any *Mass* or *Bulk*, which *GOD* can take something away

from when he pleaseth, can be called *Interminate*.

I answer, *Secondly*, that there is a great difference betwixt that which is *Infinite*, and a thing *Indefinite*; for we cannot assert any thing to be *Infinite*, except we have a Reason whereby we can demonstrate it is so: Whereas to assert any thing to be *Indefinite*, it is sufficient, if we have no Argument which proves it to be *Finite*. Which cannot be proved of the *World*; for it cannot be understood, that the *Matter* of which the *World* is made should have any *Bounds*, seeing that whatsoever we imagine beyond the *Heavens*, we still conceive it as an extended *Space*, which hath Length, Breadth and Depth, which constitute a *Body*. Of which we shall speak more fully in the *Third Chapter*.

We cannot doubt of the Perfection of the *World*, if we consider either the *Author* of it, who is *Infinite*, *All-wise*, *All-powerful*, &c. or the *Harmony* of the *Parts* of the *World*, the *Distinction* of *Natures*, and *Difference* of *Bodies* that are in it; because we meet with nothing in it which is not *Compleat* and *Perfect*.

And tho' the *World* doth not consist of things that are all best in their kind; because all particular things that are in the *World*, if considered in themselves, cannot be said to be *Perfect*, but only with reference to the whole *World*, whose parts they are. For all things that concur to the constituting of any thing, must not be of one and the same Order. What would become of a Republick, if all the *Members* of it were *Senators*? What would the *Body* of *Man* be, if it were made of nothing but *Eyes*? What would *Musick* be without *Discords*? So likewise the *Beauty* of the *World* consists in the *Diversity* of *Kinds* that are in it; and things *Imperfect*, as well as *Perfect*, contribute to its orderly and most excellent Constitution.

Wherefore this admirable Structure of the *World* would want much of its *Beauty*, without that *Vicissitude* and *Inconstancy* which we find in it. Hence it is that all things made by *GOD* are subject to *Corruption*, neither is any *Body* so firm, which in continuance of *Time* is not changed. Thus it hath been observed of late, that *Worms* are generated not only in *Stone*, but also in *Glass*; so that we may well conclude, that there are no *Bodies* in the *World* that are altogether exempt from *Corruption*.

But you'll say, Why are there so many Excrements of the *Earth*, *Air*, &c. in the *World*? Why were *Worms*, *Flies*, *Serpents*, &c. Created? since these frequently are mischievous; and other *Creatures* again perish, without having been of any use at all? I answer, that none of these things are *Superfluous* in the *World*, seeing that they are Instances of the *Power* of *GOD*, and if *Men's* Industry be not wanting, may be employ'd to many good uses. The very *Poison* of *Venemous Creatures*, by preparation and due exhibition, become great *Antidotes*; neither is there any thing so deformed in the *World*, which doth not add to its lustre and beauty, as *Shadows* set off a *Picture*.

C H A P.

XI.
The second
Answer.

XII.
The World
is Perfect.

XIII.
The Imper-
fection of
Parts, has
not away
the Perfe-
ction of the
whole.

XIV.
The Har-
mony of
the World
consists in
its Variety.

XV.
It is no
Argument
against the
Perfection
of the
World, that
some hurt-
ful things
are found
in it.

C H A P. II.

The Creation of the World proved by Natural Reason.

I.
Aristotle
supposed
the World
to be Eter-
nal.

THE Authority of ARISTOTLE hath of a long time been so prevalent in the World, that it hath been lookt upon (and is so still by some) as a great Error to depart from his Opinions: Which is more particularly evident in the matter beore us; For he supposed the World to have been from Eternity, and could not conceive how it could be produced, seeing that between Entity and Non-Entity there was an Infinite Distance. Some of his Followers have asserted the same thing, grounding their Opinion on their Masters Foundation, that out of nothing, nothing can be made, and that it was a plain contradiction, to suppose any thing to be made, but from *Præexistent matter*. Wherefore to overthrow this Opinion, so derogatory to the Glory of the Creator, I shall prove that Creation is *Naturally Demonstrable*, and that it may easily be proved, that all things proceeded from God.

II.
What Cre-
ation is.

By Creation we understand, that *Action* whereby God immediately produceth any thing. And that he hath in this manner produced all Substances, I prove thus.

III.
Everything
that exists
must have
a Cause
assigned it.

There is nothing in the Universe, whereof we may not enquire whence it *Exists*; or what is the cause of its Nature, and the efficient of its Existence. And this may not only be enquired concerning things Created, but likewise of God himself; who tho' he be Independent, Infinite and Omnipotent, yet it may be said, that his Immensity is the cause or formal Reason, why he needs no cause for his Existence. But forasmuch, as nothing like this is found in all other things, but rather the greatest Limitation and Infirmity, we must conclude, that they never proceeded from themselves, but from an outward Principle, and that they derive their whole Essence and Existence from another. For it is most evident, that nothing (if I may speak so amongst Philosophers) preceded their Natures, and that they came to be, by the Goodwill of the Creator, which is to be Created, and to proceed without dependence upon any other Cause whatsoever.

IV.
Since the
World can-
not pre-
serve it
self, it did
not make
it self.

The same may be proved from the Preservation of all things: For it cannot be conceived, how a thing that cannot preserve it self, should proceed from it self; for if a thing be supposed sufficient to afford it self a Being, we cannot but conclude, that it would bestow upon it self, all those Perfections it hath any Idea of; and seeing Conservation is one of these, neither would he deny it self this. For it is the sense of Philosophers, that Conservation differs only notionally from Creation; and that it is the work of the same Agent, to produce an effect at first, and to preserve it by a continual influx. Now it is evident by Experience, that no Created things can preserve themselves, therefore neither can they produce or Create themselves.

V.
The parts
of Time do
not depend
on them-
selves.

This will appear more clearly if we divide Time, by separating the several moments of it from each other: For it is evident, that there is no Union between them, and that each single part of it, hath no dependance at all upon the rest. For it doth not follow, that because I was the last year,

therefore I shall be the next year, seeing that I may die, in the very moment that I am writing this. Conclude we therefore that that Being cannot produce it self, which cannot preserve it self; seeing that Conservation is nothing else, but a kind of continued Production, which is only by our Understanding distinct from Creation.

All this Discourse is very accommodate to our way of conceiving. For if it be true, that that *Exists*, which we understand to be without its Causes; then that also will be possible, which is clearly and distinctly known by us to be such: But we clearly and distinctly perceive, that it is possible for the World to have been Created; therefore we must conclude, that it was actually Created, since nothing is found in the Universe, which is not dependent. For if Independence did belong to the Sun, for Example, or the Earth, the Sun and the Earth would be God, because Independence cannot be without Infinity and Omnipotence. Whence it follows, that either Creation must be admitted, or we must expose our selves to one of these two Absurdities; either that there is something in the World, that had no Maker; or that in the subordination of Causes, there may be a procession to Infinity, both which are inconsistent with Reason. It is absurd to admit any thing in Nature, which was neither of it self, nor produced by another. For whatsoever the Mind of Man can conceive, is either of it self, and then it is God, since in the Conception of God all manner of Independence is included: Or is from another; and of that other we must enquire again, whether it be of another, or of nothing; if it be said from another, we must further enquire of that other, until at last we come to that one Principle, which hath brought forth all things.

For we are not to imagin with some Atheists, that the Creatures are joynd together like Links in a Chain, which tho' they be all linked together, yet is there no necessity that the Chain made by them, should be united to another Chain; because the parts of a Chain are not produced of themselves; but only keep some order amongst themselves. Now it is not in the least contradictory, that two distinct things should be united together. We know that all things produced, are caused by another, and that therefore it is necessary, that one thing as to its Existence should be before another; for the Effect is after its Cause, as receiving its Being from it. And thus of necessity we must at last come to one Primary Cause, which produced those effects, or else must proceed to Infinity, which is the greatest absurdity in Philosophy, seeing that nothing is more evident than that a Determinate effect, must come from a Determinate Cause: But how can this be, if we can never come to the First Efficient Cause, but still a further cause may be assigned, from whence the effect proceeds? Wherefore we must conclude, that there is some Determinate Cause, from which all other things flow and are produced.

This Truth was owned by the Antient Philosophers, who clearly perceived that the Mind of Man and Intelligences in their Production, did not depend on any Præexistent matter, as being altogether different in their Nature from it.

Moreover,

VI.
If the
World had
not been
made, it
would be
God.

VII.
Things are
not so con-
nected as
to have no
dependence
upon the
first prin-
ciple.

VIII.
The Philo-
sophers con-
sidered the
Crea-
tion.

IX.
It implies
a Contra-
diction
that there
are more
Indepen-
dent Beings
than one.

X.
Many mat-
ters of
Faith may
be manifest
by natural
Reason.

XI.
Three sorts
of Quest-
ions.

XII
Whether
the World
could have
been sooner
Created
than it
was.

Moreover, who sees not that it implies a contradiction, that there should be more than one Being of and from it self, that is, Infinite, Omnipotent, Immense, &c. For whatsoever Being is of it self, must include all Perfections; and consequently, if all the things we see in the World, were their own Makers, there will be so many Infinite Beings, as we conceive that there are Independent things: Which is contrary to the order of things, and to the Light of Nature. Wherefore ARISTOTLE attributes to his Heaven, Immutability, the highest Perfection, and Divinity it self: As is evident to him that reads his Book, de Caelo. cap. 2. & 6. Ethic. cap. 7.

Neither doth it thwart what hath been said, that the Creation of the World is one of the Articles of our Faith: For Faith is not contradictory to Reason; yea, we may search out many things by Reason, which we embrace with a Firm Faith, from the Divine Revelation.

And that we may the better distinguish these Points, from those things which are matter of Faith only, we are to observe that there are three general Heads of Questions: Some are such as we first assent to by Faith only, such are the Mysteries of the Trinity and Incarnation. Other Questions are such, which tho' they belong to Faith, yet may be searched out by Reason, as the Unity of God, the Creation of the World, the Existence of God, and the Immortality of the Soul Man. And the last sort of Questions are such, as do not at all belong to Faith, but Human Reason: Such as are about Gold to be made by the Art of Chymistry, the Squaring of a Circle, and such like. As to the first sort of Questions, tho' they exceed the reach of Mans understanding, yet we are to believe them to be most true, because revealed to us by the Holy Ghost: Such points as these are indeed above Reason, tho' not contrary to it. Concerning the middle sort of these Questions, Philosophers may enquire, and shew that they are so far from being contrary to Reason, that they may be found out, cleared, and confirmed by it. As appears in this Question of the Creation of the World, in the handling whereof, I think, I have made it evident that the World could have no other Original but that of Creation.

Some curious person may enquire, why the World was Created just at such a time, and neither sooner nor later?

I answer in the First place, that before the Creation of the World there was no Time: For seeing Time is the measure of successive Duration, I do not see how possibly it could have any Being, before the Existence of changeable things. And therefore St. Austin Lib. 5. de Genes ad Litt. cap. 5. saith, It is in vain to look for Time before the Creation, as if Time could be before the Creature was. For if there was no motion of any Spiritual or Bodily Creature, by means whereof future things might succeed to things that are Past, by the present, there would be no Time at all; nor could the Creature be moved before it was. Wherefore Time rather had its Beginning from the Creature, than the Creature from Time, and both of them from God. Therefore to speak exactly, the World did not begin to be in Time, but had its Beginning with Time: And consequently, they speak very improperly, who say, the World might have been sooner

or later produced, because these expressions denote Parts of Time: Now it is apparent that Time presupposeth the World and the Creatures, and is a concomitant of them.

CHAP. III.

The World is not Circumscribed by any Figure or Bounds.

THOSE who derive all Knowledge from their Senses, cannot conceive that there should be any sensible parts of matter, of which Bodies are framed, only for this Reason because they cannot see, or perceive them by any of their Senses. For they think it to be an absurd thing, that any thing should be represented to the Mind, which comes not in by the Senses.

There are some of these, who after that they have asserted, that all the Bodies in the World consist of three Dimensions, and that none of them can be imagined so small, but that they consist of various Sides and Surfaces, do conclude the World to be of a Round or Spherical Figure, so that all the Lines drawn from its Center to the Circumference are equal. The chief ground of this their assertion is, because a Round Figure is the most perfect of all, and most conservative of the Body to which it belongs: And that the Universe, as being the most noble of all Creatures, must needs have the most excellent and useful Figure. And they defend their Opinion by ARISTOTLES Authority, who saith, that nothing is corrupted but by its contrary; and that seeing the Heavenly Bodies, are Ingenerable, and Incorruptible; it was necessary they should have such a Figure whose motion hath no contrary.

But ARISTOTLES Authority must not be more prevalent with us than Reason; for if a Round Figure were conducive to the everlasting Permanence of things, it would follow, that things of that Figure must be Incorruptible: Yea, it would depend on our Will to make things Incorruptible; since it is in our Power to make Wood, Wax and such like Bodies of a Round Figure. Nay, if this were true, there would be no Bodies in Nature, but what would be Incorruptible, forasmuch as all of them have some kind of Roundness, because a Circular Figure lies hid under their Angles; and therefore a Cubical or Square Body, as to its Spherical Figure would be Incorruptible, whereas its Angles, which cover the said Roundness would at the same time be Corruptible.

Neither is a Round, more excellent than any other Figure; for seeing that every Figure, especially those that are Regular, have their Beauty, yea, and that those are looked upon to be more curious, which have most of variety, why should not a Body of 8, 12 or 20 Sides, be more excellent as to its Figure, than a Globe? Or shall we think a Round Figure to be most beautiful because it is most smooth, and most even? If so, why are not all precious Stones rather formed into a Round Figure? And why is not Man, who is the most excellent of all other Creatures, of the same Shape? Wherefore I will conclude with VELLEIUS; I Wonder at those who will have the World to be a Living Creature, Immortal, Happy and of a Round Figure, because PLATO denies that any Figure is more Beautiful than it; whereas in my Mind, that of a

N n

Cylinder,

I.
Some deny
insensible
parts in
Bodies, be-
cause they
cannot see
them.

II.
Some sup-
pose the
World to
be of a
Round Fi-
gure.

III.
A Round
Figure con-
duceth
nothing
to the In-
corrupti-
bility of Bo-
dies.

IV.
A Round
Figure is
not the
best of all
other.

a Cylinder, or a Square, or a Long Figure, or Pyramid do exceed it.

V.
No Bounds
can be as-
signed to
the World.

But if we consider the Nature of a Body or Matter, we shall be convinced, that no Figure can be ascribed to the World: For the essence of a Body consists in Extension, so that whatsoever hath three Dimensions must be a Body. Which being granted, it will follow, that the whole World cannot be terminated by any Figure, because whatsoever we can imagin without the Bounds of that Figure, must be a Body, neither can it otherwise be conceived by us, than as extended in Length Breadth and Depth: For Nature abhors a Vacuum, neither can any space be assigned, which is altogether empty, that is, devoid of any Corporeal Substance.

VI.
That the
World is
immense.

Wherefore we cannot represent the World so great to us, but that we may still conceive it greater; for tho' we may conceive that probably there are many Bodies like the Earth, that may be inhabited by diverse Animals, yet is it impossible for us to conceive many Worlds, forasmuch as that wherein we are, takes up more space than we can imagin.

VII.
An Objecti-
on fetched
from the
Termina-
tion of the
Parts of
the World.

Some endeavour to prove the World to be bounded, because it consists of divers Parts, whereof some one begins its Magnitude, and some other terminates it; and seeing that all the Parts of Matter are bounded, that which results from them must needs be terminated also; because every thing that is Divisible is Finite.

VIII.
Answer.

This Argument, how much soever they may value themselves upon it, is very inconsiderable, and more thwarts their own sentiment, than ours. For no Philosopher ever denied that Matter was Partible, since Divisibility is its property; yet no body ever acknowledged, that by dividing Matter, we can ever come to its last Particle. Wherefore they infer wrongly, that the World is Finite, because it hath Parts; for the inference from hence rather ought to be, that the World is Indefinite, seeing that beyond all the Bounds we can possibly assign it, we still find extended spaces, nor can our Imagination ever reach to any last or utmost limit that might bound it.

IX.
What we
are to un-
derstand
by the
name of
Space.

This matter will be further cleared, if we consider what Space is, and how it differs from a Body. By the name of Space we understand all that Extension, which we conceive as reaching in Length, Breadth and Depth; so that Space properly speaking is nothing else, but Internal Place, whereby the Magnitude, Figure and Situation of Bodies, amongst other Bodies are determin'd. And Space thus described doth not indeed differ from a Body, but according to our way of conceiving; because we conceive the Extension of Space, as something common and General; whereas we consider the Extension of a Body, as something Individual and Singular. As for Example, when a Tower is taken away, we imagin that its extension is also taken away, because we conceive the same as Singular, and belonging only to it, and suppose the Extension of the place, wherein the Tower was contained, to remain the same, tho' another Building be erected in the same place, or some other like Body be placed there. Because here Extension is considered in common, and is lookt upon to be the same, whether of a Building, the Air, or any other Body, so it be but of the same Bigness and Figure, and in the same Relation, of Distance or

Nearness, to those External Bodies which determine that place.

We see then, that it is the same Extension that constitutes the Nature of a Body and Space, and that there is no other difference between these two, but that which there is between a Genus or Species and an Individual, that is, between the Nature of a Man considered in General, and that of Anthony or John. And as we say, that a Whole includes all its Parts, and all the Parts united together, comprehend the Whole: So tho' Space be said to include a Body, and a Body to be placed in a Space, yet cannot a Space and Body on that account be said to be really distinguish'd, seeing that the World, which comprehends all things, is not conceived really distinct, from all the Parts contained in it.

X.
Space and
Body are
the same.

Forasmuch therefore as we can imagin no end to Extension or Matter, but that beyond it we still conceive further Spaces, we must needs assert this World to be Indefinitely extended, and that it cannot be bounded by any Figure whatsoever. And tho' we will not arrogate so much, as to suppose our Mind to be the measure of Truth; yet we say, that it must be the measure of whatsoever we do affirm or deny. For it is absurd for us to pass our Sentence concerning any thing, whose Nature we know we cannot reach. Wherefore we make no difficulty, to assert the World to be Indefinitely extended, seeing we can conceive no Bounds in it.

XI.
That there
are no
Bounds be-
yond the
World.

CHAP. IV.

The matter of Heavenly and Earthly Bodies, it one and same.

IT hath been a frequent Controversy amongst Philosophers, whether the Matter of Heaven were the same with that of Sublunary things. ARISTOTLE supposing the Heavenly Bodies to be Incorruptible, will have their matter to be distinct from ours; so that, according to him, there are two parts in the World, the one Elementary, the other Celestial. He makes the matter of Heaven to be Ingenerable and Impassible; whereas the Elementary is subject to changes, capable of all forms, and craving those it wants. For if we may believe him, the Heavens never suffered any change, and continue still in the same state wherein they were Created. Because Generation and corruption are only found amongst contraries; and seeing nothing is contrary to the Heavenly Body, because its motion is such, as to be contrary to none; for one motion, according to him, can only be opposite to another motion; and since motion upwards, is contrary to that which is downwards, it is necessary that Circular motion, which is proper to the Heavens, must have no contrary, and therefore that Body which is so moved must be Incorruptible.

I.
Aristotles
Opinion
concerning
the matter
of Heav-
enly and
sublunary
things.

But what if we should grant the Heavenly Bodies to be Ingenerable and Incorruptible, yet would it not follow from thence that they are not subject to any changes, which we may prove by ARISTOTLES own Argument. Those things may be generated and corrupted, that have their Contraries; but that which is Ingenerable and Incorruptible, is contrary to that which is Generable and Corruptible; therefore the Celestial Orbs are Corruptible

II.
Aristotles
Argument
retained
on him, and
confuted.

ruptible and Generable. But to leave these Reasonings, let us see what may be alledged against ARISTOTLES Opinion. For asmuch as the Modern Astronomers, have more exactly viewd the Stars than the Antients, I question not, but that were ARISTOTLE now alive, and made use of our Telescopes, he would be of their Opinion. For they observe that the Sun is frequently obscured by Spots which obscure its face, and that these at some certain times are so condensed, that the Light of the Sun for some Months together, appears much weaker. Now that these are generated, cannot be denied, since almost every day they change their Form; they are sometimes of a Black colour, at other times they seem to have a Dusky appearance of Light; yea sometimes they are of that loose texture, that they exceed the Sun in Brightness. All which could not be without Generation and Alteration.

III. The Planets subject to changes. The changes which happen to the Planets confirm the same thing; for what is more infatible than these wandering Stars? The Moon almost every day gives a various Representation of herself. Saturn seldom appears with the same face. How frequently is Jupiter clouded with Spots, which interrupt its Light from coming to us? Venus is continually changing, and if we may give credit to the information of the Telescope, we must assert her to have several Faces; since she does not only change her aspect, but also her Bulk and Figure, as Astronomers tell us it happen, in the time of King Ogiges. Moreover, how many Comets and New Stars, do there appear in the Heavens, as the Star in Cassiopea, and others that appeared in the Heavens in 1572 and 1604, above the height of the Planets. All which PHÆNOMENA may be sufficient to make the followers of ARISTOTLE to reject this foolish Opinion of their Master, and to acknowledge the Corruptibility of the Heavens.

IV. The Mathematicians have described many new Stars. Neither are we to be moved by what ARISTOTLE tells us, that he never perceived any such thing in the Heavens, where he saith; This is likewise abundantly confirmed by Sense; seeing that according to the Records of all past time, never any such change hath happened in the whole utmost Heaven, nor in any of its proper parts. Well, let us be so favourable to ARISTOTLE, as to take this to be true; but can it be inferred from hence, that no further observations could be made for time to come? For we read that HIPPARCHUS, 200 years after ARISTOTLE, found out a new Star, by the motion whereof he began to question, whether this might not happen more frequently, and whether the fixt Stars also might not have a motion of their own. We know likewise that TYCHOBRAHE descried the foresaid Star in Cassiopea in the Region of the fixed Stars, above Saturn.

V. Wherein the Essence of Matter doth precisely consist. But we may put the Point beyond all Controversy, considering wherein the Essence of a Body doth consist, and by removing from it whatsoever is Extraneous to it. Thus in the first place it appears, that sensible Qualities are no constituents of it, since it can be without them, and loseth nothing, when they perish. Air, which is soft to the Touch, doth not change its Nature, when by being shut up in a Bladder, it appears hard. A Bean is of considerable Hardness, as long as it abides whole, but when reduced to Flower, it becomes soft. But the Air and the Bean continues Bodies for all that.

Neither do Figure, or Motion conduce any thing to the constitution of Matter, since the World which is of no Figure at all, or at least cannot be conceived by the Mind of Man, under any Bounds, still continues to have the Nature of a Body. And the Heavens, which are considered as immoveable, do not therefore cease to be material. And the same may be said of Heat and Cold, and other like Qualities, which may be absent from a Body, its Nature continuing whole and entire.

VI. The matter of Heaven and Earth consists in Extension. We conclude therefore, that nothing but Extension constitutes the Essence of Matter, since that alone cannot be separated from it, and is Reciprocated with it. For if you take away Extension, the Body is gone, as when you take away the Body, the Extension is no more.

VII. The matter of the Heaven and of Sublunary things is the same. Forasmuch therefore as the Matter of the Heavens in Length, is extended in Length Breadth and Depth, and that no thing but this Extension is included in the Conception of it, we conclude that the matter of Heaven and Earth is one and the same, and consequently that the Matter of the Heavens is as well subject to Corruption and Changes as that of the Earth is.

VIII. Objection that the matter of Heaven and Earth is not under the same Forms. You'll say, that the Heavenly Matter is not under the same Forms as Sublunary things are, because it was never known that Heaven was generated of the Air, or that a Star was changed into an Earthly Body.

IX. There are no Forms but may exist in Matter. If by the name of Forms, in the Objection, be understood those Substantial Principles, which have a different Being from the Matter, and together with it constitute a Natural Compound, I say, that such Forms as these are meer Fictions, and useless to the explaining of Natural Effects. For such Forms must be either Material or Immaterial. If Immaterial, of what use can they be to Matter? How can they perfect it, and communicate to it their Essence, since Matter (according to them) is meer Potentiality, which derives all its Existence from these Substantial Forms. For how can that which hath no Parts, constitute the Essence of a Material thing? But if they suppose these Forms to be Material, then must they of necessity be constituted by Extension, and must be subject to the self same Modes of Variation, which all other Bodies are. For it cannot be conceived that a thing should be extended, without being liable to the change of Figure, Motion, Magnitude, Rest and Situation: And forasmuch as Generation is nothing else but a congruous Adaptation of the Insensible or Sensible Parts, according to the foresaid Modifications, we must conclude, that all Matter is subject to Changes, and consequently, the Elementary Matter doth not differ from the Heavenly.

CHAP. V.

What the Form of the World is: Whether it be the Soul, that is, the Spirit of Nature, or the most excellent Disposition of its Parts.

I. The Opinion of Pythagoras and Plato concerning the Soul of the World. There is nothing that hath been more controverted amongst the Ancients than this Question, Whether the World be endued with a Soul, and vivified by an Internal Spirit, diffus'd throughout all its Parts. Pythagoras and Plato have compared the Universe to Man, and maintain'd it to be

The Opinion of Pythagoras and Plato concerning the Soul of the World.

be furnish'd not only with *Life* and *Sense*, but also with *Understanding*. For they could not conceive, how that which was devoid of *Sense*, should produce *Sensible* things. And therefore as there is in us a *Power* whereby we *live*, are *sensible*, and *move*, they thought that so likewise in the *World* there must be a *Principle*, from whence all its *Operations* flow; which the *Poet* describes thus,

*The whole, an Inward Spirit doth maintain,
And a great Soul infus'd through ev'ry Vein
Th' unweildy Mass doth move.*

II.
What the
Soul of the
World is,
according
to Plato.

Tho' *Plato* suppos'd the *Soul* of the *World* to be like that which is in *Animals*; yet he holds it not to be a *simple Substance*, but compounded of two *Parts*; the one purely *Intellectual*, the other more *Impure*, tho' *Pure*, if compared with the *Grossness* of *Bodies*; and this he makes a kind of *Vehicle* of the *Immaterial part*. So that he makes a distinction between the *Mind* and the *Soul*; the *Mind* being a *Substance* void of all *Matter*, which is the *Higher part* of the *Soul* of the *World*; and the *Soul* being nothing else but the most *subtil Ether*, by means whereof the *Mind* is brought and united to the *Body*.

III.
In what
sense this
Opinion of
Plato may
be admis-
sed.

Tho' this *Opinion* of *Plato* at first sight appears strange and absurd; yet in a sound *Sense* it may be asserted. For if by the *Soul* of the *World* he meant nothing else but *GOD* himself, who holds together the dispersed *Parts* of the *World*, animating, governing and cherishing them, it contains nothing contrary to *Faith* or *Reason*: Provided always, that *GOD* be understood not to be the *Informing Soul* of the *World*, that is, a *Constitutive part* of it; but an *Assistant form* only, that is, the *Ruler and Governour* of *Nature*. For *GOD* is the *Moderator* of all *Things*, and is present to all *Things*, whether *Intellectual* or *Bodily*, operating in them, and by them, according to that of the *Acts* 17. 28. *In him we live, move, and have our Being*.

IV.
Absurdities
consequent
to Plato's
Opinion.

But if *Plato's* meaning was, That this *Universe* was endued with a true *Soul*, and accordingly was a *Real Animal*, from whence all other *Animals* are generated, nothing seems more absurd, than to suppose an *Animal* compounded of an infinite sort of other *Animals*, which feeds upon it self, and yet is destitute of *Sight*, *Hearing*, and the other *Senses*. What, are the *Stars* nourished with *terrene Exhalations*? Or is the *Earth* supported by *Emanations* from the *Body* of the *Moon*? Who will believe such stuff as this? If the *Earth* be sensible, what shall we say of those hard-Hearted *Husbandmen*, which do cut and wound it with their *Plough-shares*? Besides, if we grant the *Earth* to be *Animate*, must not *Stones*, *Iron* and *Water* be so likewise; yea, all other things of the *World*? But you'll say, *Living Creatures* are generated out of the *World*. What then? Must I thence conclude that the *World* is an *Animal*? Why may not I as well conclude the *World* to be all *Stony*, because *Stones* are generated out of it? Or of *Iron*, because its *Bowels* produce *Iron*? Yea, why may I not with equal ground conclude the *World* to be a *Fidler*, or a *Mathematician*, because such are born in it? For tho' whatsoever hath its *Original* in the *World*, doth derive the same from something that is in the *World*; yet not therefore

from the *Soul* of the *World*, that is diffused throughout it, seeing that the *World* contains all manner of things, whether *Animate* or *Inanimate*.

But to urge this with more *Philosophical Arguments*, I say, that upon this Supposition of a *Soul* being diffus'd throughout the whole *World*, it will follow that there can be no *Passion* of *Joy* or *Sorrow* in the *World*, but what all *Men* must be sensible of, and that no *Body* can wound or strike another, without feeling the same himself. For if one *Sensitive* and *Rational Soul* governs and animates the *World*, there must accordingly be but one *Animadversion*, that is, one part of it must perceive whatsoever the other parts do. But we experience the contrary to all this, and therefore must conclude, that there is no such common *Soul* in the *World*.

For otherwise we should not only apprehend things offer'd to our *Mind*, but we should also remember those things, which were never committed to our *Memory*: For seeing that this *Universal Soul* contains all things, and is diffus'd through all, nothing of all the things that are acted any where, could be hid from it; and therefore since by it we perceive *Objects*, and remember them, it must necessarily follow that the *Mind* must behold those things as present, which it never enquir'd after; that is, it must remember those things, which it never perceived.

Moreover, if we suppose the *World* to be whirl'd about its *Axis* in 24 Hours time, it will follow, that whatsoever I set about when the *Earth* is in the Beginning of *Aries*, I shall remember to have done the same when the *Earth* is in the Beginning of *Libra*; tho' that *Portion* of the *Soul* of the *World*, which informs my *Body* at that time, be then as far from me, as the *Earth* is from the *Sun*. Which *Arguments* sufficiently prove, that there cannot be a *Soul* common to all *Men*.

Doctor *More*, tho' he doth not defend *Plato's* Opinion concerning the *Soul* of the *World*, and thinks it absurd, that a *Substance* endued with *Sense* and *Reason* should be mingled with all the *Parts* of the *World*; yet he admits of a *Spirit* of *Nature*, which penetrates all the *Matter* whereof the *World* consists, and exerts its *Power* in it, which *Spirit* he describes to be (in his *Third Book* of the *Immortality of the Soul*) an *Incorporeal Substance*, but destitute of *Sense* and *Animadversion*, penetrating the whole *Matter* of the *Universe*, and exercising a *Plastick* virtue in the same, according to the various disposition of the *Parts* in which it operates, directing the *Parts* of *Matter*, and their *Motions*, and discovering those *Phænomena* in the *World*, which cannot be resolv'd into meer *Mechanical Causes*.

The *Arguments* that persuaded the *Doctor* to admit this *Spirit* of the *World*, were the *Trembling* of an *Unison String*; *Sympathetick Cures*; the *Sympathy* there is between *Heavenly* and *Earthly Bodies*; *Monstrous Birds*; the *Magnetick Attraction* of *Iron*; and lastly, the *Spherical Figure* of the *Sun*. For he could not apprehend how the *Unison Strings* of different *Instruments* do all of them shake, if *One* only be touch'd, without the assistance of this *Spirit* of the *World*. How by the *Weapon-Salve* a *Wound* can be Cured at a great

V.
Supposing
one common
Soul of the
World, all
Men would
feel the
same thing.

VI.
And would
remember
things they
never had
perceived.

VII.
Yea, and
would re-
member
those things
as done in
one Part of
the World,
which were
done in
another.

VIII.
Henry
More's
Opinion of
the Spirit
of Nature.

IX.
Experi-
ments to
prove the
Spirit of
Nature.

great distance. How the *Heavenly Bodies*, which are assumed by *Magicians* and *Witches*, do communicate their Affections to *Earthly things*; and how it comes to pass, that the same things that hurt those, do mischief to these also. How *Monstrous Birds* come to be generated in a *Human Womb*. How it comes to pass that *Iron* is attracted by the *Loadstone*, and of it self, without any impelling Cause is carried towards it. How the *Sun* attain'd its *Round Figure*, except this *Spirit of Nature* be admitted, permeating all the *Matter of the World*, into which all these *Phænomena* may be resolved.

X.
Why an
Unison
String
trembles
at the
shaking of
another on
a different
Instrument.

But I see no necessity of having recourse to a *Spirit of the World* for the explaining these *Phænomena*, since it may better be done by *Mechanical Principles*. For, as to the *First*, the *Trembling* of an *Unison String*, upon the striking of another, whilst all the other Strings remain without any Motion; this is caused by the vibration of the *String* struck; which moving the *Air*, the *Air* reacheth the *String* that's wound up to the same pitch, and makes it tremble; the *Trembling Motion* being easily communicated to a *Body* disposed for such a *Trembling*; and therefore no wonder if it give forth the very same *Sound*. Whereas if the *Trembling Air* rusheth against a *String* that is differently wound up, by giving several hits against it, it hinders it from reverberating; so that it is impossible for it to sound as the other doth. Yet we must not imagine, that only those *Strings* which are tun'd alike do shake, since they do all, or most of them shake; tho' those only do sound, which are in *Unison* or *Diapason*, or some other Concord with the *String* struck.

XI.
Whether
Wounds
are Cured
by the
Sympathetick
Powder.

As to the *Cure of Wounds* by the *Sympathetick Ointment*, or the *Powder of Calcin'd Vitriol*, and that at a great distance; this is a thing which may very well be question'd. For what is there in *Vitriol* to perform this, save only an *Adstringent* virtue, whereby it is proper to stop *Blood*, and to bring it to a *Scar*? But by what means shall the outflowing *Particles* thereof be guided to the *Wound*, since they only exert themselves to a very small distance? Whence the *Doctor* concludes, they are directed to the *Wound* by this *Spirit of Nature*. But forasmuch as this *Spirit* is diffus'd throughout all the *World*, and indifferently present to all *Wounds*, why doth it rather heal that whence the *Blood* came, than all the rest, since it is destitute of *Sense* and *Animadversion*, and is no more present to that *Wound*, which it is supposed to *Cure*, than to any other? Wherefore when a *Wound* at a great distance happens to be Cur'd this way, the *Cure* is not to be ascribed to the *Powder* or *Weapon-Salve*, which is apply'd to the *Instrument* that made the *wound*; but it seems to happen, because the *wound* is kept clean and wash'd with *Urine*; as is prescrib'd in this case: For *Salt of Urine* is very deterfiv and adstringive, and therefore readily closeth the *Mouths* of the *Veins*, consolidates the *Parts*, and skins them over.

XII.
There is no
sympathy
between
Heavenly
and Earthly
Bodies.

As to that particular of *Mens Souls* sometimes quitting their *Bodies*, and appearing in the shape of a *Cat*, *Dog*, &c. and that whatsoever is inflicted on these assumed *Bodies*, doth redound to the hurt of their true *Earthly Bodies*; this I take to be impossible, and therefore think it in vain to

trouble my self about searching out the Reason of it.

As to those *Monstrous Birds* and *Animals*, that sometimes proceed from the *Wombs* of *Women*, there seems no necessity to put this drudgery upon this *Spirit of Nature*, when it may be more commodiously explicated by a propension in the *Matter* apposite to the *Forming Power*, and the intention of *Nature*. Thus we find that the *Seed of Coleworts* degenerates into *Turneps*; and why may not we as well suppose that the *Parts* of an *Animal* may be perverted, by manifold defects of the motions and humors of the *Womb*, discomposing and altering the *Seed*. And indeed, what wonder is it for a *Woman* to bring forth a *Monster*, when we see the *Body of Man* familiarly to breed *Lice*, which are dreadful Monsters when beheld with a *Microscope*. Seeing therefore that *Lice* and *Worms* are apt to be generated, especially where the *Parts* of the *Body* are ill affected; it will not seem strange that in a depraved state of the *Womb* *Monsters* should be generated. But of *Monstrous Births*, see more in my *History of Nature*.

XIII.
How Monstrous Birds are framed in the Wombs of Women.

The Reason of the *Leadstone* drawing *Iron*, shall be treated at large in the *Tenth Chapter of the Sixth Part*. And so likewise the Cause of the *Round Figure* of the *Sun*, and *Fix'd Stars*, will be handled in the *Fourteenth Chapter* of this *Part*; to which I refer the *Reader*, to avoid Repetitions.

XIV.
Magnetick virtue in the Leadstone, elsewhere handled at large.

Forasmuch therefore as the *World* is not endued with a *Soul*, or any *Spirit of Nature*, there being no need of either of them for explaining any *Natural Phænomena*, we conclude, that the *Form* of the *World* is nothing else, but the fit disposition of all its *Parts*, and their intimate Union. For such is the constitution of the *Parts* of the *World*, that tho' they be different, and at a distance from each other; yet they have a mutual *Relation* and *Reference*, and are joyned together by a *virtue* that penetrates them all. But what *virtue* is this that unites them? I answer, that it is the *Subtil* or *Ethereal Matter*, which permeating all *Bodies* is the cause of this *Union* and *Harmony*, as *LUCRETIVS* seems to hint, *Lib. 5.*

XV.
The Form of the World consists in the most excellent Constitution of its parts.

The Fluids are all differently Light,
And therefore reach'd the less or greater height.
Then Liquid Ether did the farthest rear,
And lies on softest Beds of yielding Air.

CHAP. VI.

That GOD, as he is the Efficient and Con-serving Cause of Matter, so likewise of Motion.

HAVING thus explain'd the *Nature* of the *World's Matter*, and enquired of the *Soul* that acts it, it remains now that we consider, whether the same quantity of *Matter* always remains in the *World*, or whether it be increased or diminished. Some are so stupid as to imagine, that when *Fire* is extinguish'd, it wholly periseth; not considering that *GOD* is the *Creatour* of all things, and that the *Creatures* cannot destroy any thing, which his *Omnipotence* hath produced. For tho' the subtil particles of *Fire*, may by a *Fan*, *Bellows*, or the blast of ones *Breath* be dissipated; yet are not they therefore annihilated, but being separated

I.
Nothing in the World is annihilated.

rated exist in another manner than they did before. For as *Division* doth not make *Matter*, so neither can it destroy it: Wherefore, *Matter* divided loseth nothing of its *extension*, but only ceaseth to be such a *Body*, and becomes changed into another. It is a great mistake to suppose, that those things which cease to affect our *Senses*, are altogether destroyed and annihilated.

II.
Matter is
neither
subject to
Generation,
nor Cor-
ruption.

Matter, according to the Opinion of all *Philosophers*, is neither *subject to Generation*, nor *Corruption*: Wherefore, we must conclude, that there is always the same *quantity* of it. For indeed how can any new *Matter* enter, seeing there is no *Vacuum*, and that the *penetration of Bodies* implies a *Contradiction*? For if any one part of the *Eyes* suppose, should be taken away or annihilated (as they fancy of the *Fire*, when it goes out) it is certain a *Space* must be left in the room of it, which forasmuch as it hath *length*, *breadth* and *depth*, we must say that another *Body* supplies the place of it. For it becomes the *Infinite Power* of *GOD*, to act in the most *constant* and *unchangeable* manner, by preserving that which he hath produced without increase or diminution.

III.
How New
Bodies are
brought
forth in
the World.

But you'll say, That we daily see new *Parts of Matter* appearing, which were never before: Thus in *Spring time* many *Herbs and Flowers* shoot forth from the *Earth*; and in *Autumn*, the *Trees* are laden with *Fruits*, which did not exist before. Wherefore we may conclude, that the *Substance of Matter* is increased.

This Difficulty may be easily solved, by distinguishing between the *First* and *Second Matter*. By the *First Matter* is understood a *Body* in its general Notion, as it includes three Dimensions. By the *Second Matter* is meant a *Body*, which besides *Extension*, is endued with *Figure* and other Modifications, by which it comes to resort under one or other of the *General Heads of things*. Wherefore a *Body* in this sense is not to be called *Simple Matter*, but something compounded of an *Extended Substance*, and one or more *Modifications*. Thus a *Tulip*, for Example, besides *Extension*, implies such a conformity of *Leaves*, which at different Seasons rise and perish. And this *Second Matter* admits some kind of *Latitude*, and may be multiplied or diminished. But the *First Matter* is *Indivisible*, seeing that all *Bodies* agree in *Extension*; the *Soft* and *Insensible*, as well as the *Hard* and *Sensible*. And such *Matter* as this, is neither subject to *Generation* or *Corruption*, and consequently can neither increase or be diminished, being only capable of admitting different *Modifications*, and of assuming divers *Forms*.

IV.
GOD is the
Cause of
the Motion
that is in
the World.

And the same is the case with *Motion*, forasmuch as all things proceeding from *GOD*, depend on him in a peculiar manner, and have nothing of *Truth* or *Goodness*, but what they have received of him: And that *Independency* is the necessary *Attribute* of a most *Perfect Being*, as *Dependency*, as to *Being* and *Conservation* is the *Attribute* of all *Creatures*. For who can believe that the *Motion* of the *Stars* about their several *Centers*, the Course of *Rivers*, the daily *Ebbing and Flowing* of the *Sea*, and the *Earths* being poised in the *Liquid Air*, are caused and continued by *Chance*? It implies a *Contradiction* to suppose these *Regular Effects* to be produced by any Power, besides that of a most *Perfect Being*, who not only created *Matter*, but

also imparted *Motion* and *Rest* unto it. And since the *Conservation* of any thing is a continued *Creation*, we must conclude, that *GOD* is the *Preserver* of that *Motion*, which at the Beginning he imparted to the *World*.

So that as *GOD* preserves the same *Quantity* of *Matter* which he created, so likewise of *Motion*, and that without increase or decrease; which is a remarkable *Proof* of *GOD's Wisdom* and *Unchangableness*. And as for *Matter*, as it could not move it self at first; so it being once put in *motion*, it never ceaseth from it, but continues in the *state* wherein it is put. So that if the *Motion* that is in the *World* should either be diminished, or cease altogether, this must be from the *Divine Will* appointing it so; but no such *Will* of *GOD* appearing, it is certain the same *Quantity* of *Motion* must still continue in the *World*.

When I say, that the same *Quantity* of *Motion* is preserv'd in the *Universe*; this is not so to be understood, as if all *Bodies* that were first put into *motion*, continue in the same *motion*; and that those that were left at *Rest*, do persevere in the same; but that the same *measure* of *Motion* is preserved in the whole *Universe*, tho' it may be varied and alter'd in the particular *Parts* of it, with respect to the diverse *Bodies*, on which it exerciseth its force. Much in the same manner, as we say, that in a certain *Kingdom* there is such a determinate *quantity* of *Money*, tho' some Men have more of it, and others less, and tho' it be in a continual Relation from one to another. So likewise we must conceive, that the same *quantity* of *Motion* is found in the *Universe*, tho' the same be variously possess'd by the particular *Parts* of it.

GOD alone can be the *Cause* of this so constant *Motion* in the *Universe*. For if we consider *Motion*, we find nothing by which it should be increased or diminished, for having not produced it self, neither can it increase or destroy it self; nor can the thing moved, or matter, conduce any thing this way, because it is merely *Passive*, and consists only in *Extension*. Wherefore, we must conclude *GOD* to be the *Total* and *Universal Principle* of *Motion*; who at the first instant of the *Creation* of *Matter*, put *Motion* into it, and maintains the same by the same *Action* wherewith he preserves the *Matter* it self; that is, he makes use of the same moving *Force*, without increase or decrease, which removes from one *Body* to another, according as *GOD* applies the same to divers parts of the *World*. For it might seem to be an *Argument* of *Inconstancy* in *GOD*, if he did not maintain the same *quantity* of *Motion* in the *World*, as well as of *Matter*, and this by one and the same *Course*. So that the *Force* whereby *Matter* is moved, is nothing but *GOD* himself, who being most *Wise* and most *Powerful*, acts in the most stable manner; and therefore on his part, this *virtue* can neither increase or be diminished, but ever continues the same, tho' in particular *Subjects* it may be various.

But you'll say, *GOD* is a *Free Agent*, and that Things that are done in the *Universe* proceed from his *Will*. For who knows not, that the *Number* of Men depends on his good *Pleasure*, who produceth and preserves more or less of them, as he pleaseth? So that there seems no reason, but that there may be an unequal *measure* of *Motion* in

V.
That GOD,
as he con-
tinues the
same
Quantity
of Matter
in the
World, so
likewise of
Motion.

VI.
In what
sense it is
to be un-
derstood,
that the
same
Quantity
of Motion
is found to
continue
in the
World.

VII.
God makes
use of the
same Force,
in applying
Motion to
divers
Bodies.

VIII.
An Obje-
ction taken
from GOD's
free Action.

IX.
The First
Answer.

in the *World*, seeing that according to the *Free Will* of the *Creatour*, it may be increased or diminished.

To which I Answer, *First*, That those *Things* which depend on the alone good Pleasure of *GOD*, cannot be known but by *Divine Revelation*; wherefore the Consideration thereof does not belong to *Natural Philosophy*, wherein nothing is to be admitted, but what may be discovered by *Reason*.

X.
The Second
Answer.

In the *Second* place I Answer, That as *GOD* acts freely, so likewise he acts constantly, and immutably preserves whatsoever he hath once produced. So that we are not only to consider the *Liberty* of *GOD*, but the same in conjunction with his other *Attributes* of *Wisdom*, *Unchangableness*, &c. which all together do constitute his one *Eternal* and *Permanent Nature*. And as his *Liberty* appears in the vast Variety of the *Things* he hath made, so his *Unchangableness* is demonstrated by his conserving the same *Quantity* of *Motion* and *Rest* in the *Universe*. For *Conservation* being a continual *Production*, it would seem to argue *Changableness* in *GOD*, if either any new *Motion* should arise, or præexistent *Motion* should perish.

XI.
There can
be no In-
constancy
in Motion,
neither in
respect of
GOD, nor
of the
World.

We acknowledge indeed, that such is *GOD*'s absolute *Power* of all *Things*, that he can destroy, lessen or increase, whatsoever he hath made, according to the pleasure of his *Will*: But as long as such his *Will* is not discover'd to us, we cannot assert any thing concerning it. And seeing that with respect to the *World*, no Reason can be given for the increase or decrease of the *Motion* that is in it, we must conclude that the same force which at first put the *Matter* in *Motion*, doth still continue in it.

XII.
Whence so
many Mo-
tions arise
in the
World.

It remains now, that we explain how this *Motion*, or rather *Virtue*, that moves the *Parts* of the *Universe*, does indivisibly continue the same, when so many *New Motions* are seen every day: As when *Men*, and other *Animals*, that rested in the *Night* time, are all in *motion* in the *Day*; and when *Guns* are discharged, it is certain that the great *Concussion* caused thereby, was not before in the *World*; wherefore, it seems there must needs be more *Motion* in the *World* at one time, than at another.

XIII.
A Body
moved,
dashing
against
another,
doth com-
municate
some part
of its mo-
tion unto
it.

But this will be easily answered, if we consider that every *Body* whilst it pusheth on another, doth lose as much of its own motion, as it transfers to that *Body* it pusheth forwards. As appears in *hard Bodies*, which by dashing against any soft matter, transmit all their motion to it, and are reduced to *Rest*. Hence it is, that a *Stone* falling down from on high to the ground, doth not rebound, but lies still, because it communicates all its motion to the *Earth*. And in like manner, when *Men* or other *Animals* are moved, we must not suppose that they produce new *Motions* in the *World*, when the agitation of their *Spirits* is transmitted to their *Members*; because the more motion the *Members* receive, the less the *Spirits* retain.

XIV.
The Con-
cussion of
the Air by
Guns, does
not prove a
greater

Neither can we infer, that the *Quantity* of *Motion* is increased by the *Concussion* of the *Air*, caused by the discharge of *Canon*: For tho' there may be more of that motion which we call *sound*, yet is there no more motion simply taken: For tho' the commotion of the *Air* be at first made

more vehement, because of the narrowness of the *Space*; yet by degrees afterwards it becomes more remiss, as it spreads into wider *Intervals*, because the *Air*, having communicated its motion to the *Neighbouring Bodies*, doth lose as much agitation as it imparts to them.

Quantity
of Motion.

CHAP. VII.

Of the Action of Bodies, and the Communication of Motion.

Forasmuch as the *Matter* of the *Universe* is divided into innumerable *Parts*, and every one of them have their proper *Motions*; it cannot be doubted but that they must frequently run against one another, and by contrary motions be either hindered, retarded, or wholly reduc'd to *Rest*. Hence, according to the variety of their pushing against each other, the manifold *Action* of *Bodies*, and *Communication* of *Motions* ariseth: *First*, When two *Bodies* by *Contrary motions* run against each other: *Secondly*, When the *Body* moved, runs against a *Body* that is at *Rest*: *Thirdly*, When two *Bodies* are moved the same way, but with a different degree of *Swiftness*. For it is impossible that *Bodies* should push against one another, but that some change of *Motion* or *Rest* must follow thereupon.

I.
There is a
manifest
Communi-
cation
of Motion.

The *Communication* therefore of *Motion* consists in this, that according to the *Will* of the *First Mover*, the *Body* that doth exceed the *Body* it meets with in the *Force* of moving forward, doth carry the same along with it, and loseth as much of its *Motion*, as the other receiveth: So that the same *Quantity* of *Motion* always continues in the *World*.

II.
Wherein
the Com-
munication
of Motion
doth consist.

Neither must we infer from hence, that upon this Supposition an *Accident* must remove from one *Subject* to another; because the *Body* that is at *Rest*, doth not receive the same *Numerical Portion* of *Motion*, from the *Body* that runs against it: But forasmuch as according to the *Will* of the *First Mover*, a like motion only ariseth in that *Body*, which upon the impulse of another, begins to move (as has been before explain'd, *Part IV. Chap. XV.*) it cannot be said, that in this case an *Accident* removes from one *Subject* into another.

III.
In the Com-
munication
of Motion,
an Accident
doth not
move from
one Sub-
ject to
another.

This *Communication* of *Motion* will be the better apprehended, if we suppose the *Bodies* that are moved to be perfectly *Hard*, and so divided from all the rest, that their motion be neither hindered nor promoted by any circumjacent *Bodies*. For except *Bodies* were perfectly *Hard*, they would not be able to act upon one another; and if they were not separate from all others, so as not to be retarded or turned aside by *Ambient Bodies*, the proportion or difference of *Motions* would not be discernible.

IV.
In order to
the exact
Determina-
tion of the
Action of
Bodies, it
is required
that they
be perfectly
hard.

In the *Second* place, we are to suppose, that the medium wherein the *Bodies* move, be such as doth neither hinder nor promote the motion of them. For if the way through which they pass be either soft or fluid, it will hinder their motion, turn it aside, or wholly take it away; and so no exact account could be taken, what the *Force* of each *Body* is in acting or resisting.

V.
And that
the Medium
in which
they are
moved, be
no hin-
drance to
their Mo-
tions.

Thirdly,

VI.
A Body is not changed but from an External Cause.

Thirdly, We are to suppose, that every *Body*, forasmuch as it is simple and undivided, doth as much as in it lies, continue in the same state; nor is it ever changed, but by some *External Cause*. These things being thus far settled, we are, *first*, to enquire, what must happen at the meeting of two *Bodies*? For every one knows by Experience, that *Bodies*, whether *Moved* or *Resting*, variously change the condition wherein they are, according to the different Nature of the *Bodies* they meet with. Thus, for Example, a *Body* moved changeth its state, by meeting a *Body* that is at *Rest*, otherwise than it would by meeting with a *Body* in *motion*. It also variously changeth its *motion*, in meeting with a *hard* or *liquid* *Body*. And the *Rules*, according to which these Changes happen, are properly that which we call in general, the *Laws of Motion*.

VII.
What Direct Motion is

Lastly, We are to presuppose, that *Direct motion* is the Translation of a *Body* out of the Neighbourhood of one that is consider'd as *Resting*, into the Neighbourhood of another, by a right line, which is the shortest of all others, and equally stretch'd out between two *Points*.

VIII.
The First Rule.

Figure 15.

Suppose we therefore the two *Bodies* A and E to be equal, and to move directly towards one another with the same *swiftness*; when they come to D, they will both rebound back the contrary way, A towards the Left, and E towards the Right, with the very same *swiftness* wherewith they came to D. For these *Bodies* being supposed altogether equal, must consequently have equal force of *Moving* and *Resisting*. And seeing that *Motion* is not contrary to *Motion*, there is no cause that can reduce them to *Rest*: Wherefore we must conclude that they must reflect or rebound with the same *swiftness*, their *Motion* continuing whole and entire.

IX.
The Second Rule.

But if the *Body* A be somewhat Bigger than E, and both be moved with the same *swiftness*, A towards the Right hand, and E towards the Left, when they meet together in D, E alone will rebound, and afterwards both of them proceed to move, with the same *swiftness* towards the Right. The Reason is, because every *Body* that hath less Force, to proceed in a right line, than the other hath to resist, loseth the Determination of its *Motion*: And it being supposed that the *Body* E hath less force to proceed forwards, towards the Left, then A hath to proceed to the Right, it follows that E, must lose its Determination, that is, must rebound; but because A and E, are supposed to move with the same *swiftness*, and this *swiftness* cannot be changed by any *External cause*, therefore it remains in the same state wherein it was before. And accordingly E, will move towards the Right, with the same *swiftness* it had at first; and A retaining the same *swiftness*, without changing its Determination, will move the same way, and follow E, yet without being able to push it forward.

X.
The Third Rule.

Again, if these two *Bodies* A, and E, be supposed equal in Bulk, but that A moves somewhat swifter than E, then not only E will rebound backwards, but A will also communicate to E, the one half of its *swiftness*, wherein it exceeds E. That is, if before there had been six degrees of *swiftness* in A, and four only in E, after their meeting, they would both tend to the Right, with five degrees of *swiftness*, and so proceed to move the same way with the same *swiftness*. For seeing that the *Body* E, hath

less force to resist, than the *Body* A, against which it pusheth, hath to move it, it is agreeable to Reason, that it should give way and reflect, and suffer something from the *Body* A, and that so the *Body* A should immediately follow E. But seeing that A hath more *Swiftness*, it cannot follow E, and proceed the same way with it, without pushing it forward, and imparting so much of its *motion*, which being added to that which was in E before, makes both their *motions* to be equal. So that if A hath six degrees of *Swiftness*, and E but four; let the two degrees whereby A exceeds E, be divided into four Parts, and then let one part be communicated to E: But because thus the *motion* of A is still swifter than that of E, let the second also be communicated. And seeing that upon the Communication of these two Fourths, the *motion* of the *Body* E, is made as swift as that of the *Body* A, it will not be able to receive any farther increase from A, and therefore will retain the remaining two Fourths; and so both of them, with the same *swiftness*, that is, with five degrees of *swiftness*, will move towards the Right hand.

But if the *Body* E be wholly at *Rest*, and somewhat bigger than A, then with whatsoever *swiftness* A may be supposed to move towards E, it will never be able to move it, but will be beaten back by it, still retaining its *motion* entire. For a *Body* at *Rest* doth more resist a greater degree of *Swiftness* than a less, and that according to the degree of the Excess of the one above the other; and consequently there will always be a greater force in E to resist, than in A to push forwards. For a *Body* at *Rest*, doth as much as in it lies continue in its *Rest*, and must by some outward force be driven out of its place, before it can tend any way. Wherefore such a *Body* doth not only, with all its Parts joyn'd together, resist the *motion*; but also proportionably to its bulk, whereby it exceeds other *Bodies*, it is made more strong to withstand others that oppose it. And therefore the *Body* E, because of its greater Bulk, hath a greater Force to resist, than A hath to move. By which means it comes to pass, that it is not changed by A, but with the same Force continues in *Rest*, wherewith the whole *Body* A will be moved, and dash against it.

Now, that a *Body* at *Rest* doth more withstand a greater degree of *Swiftness*, than a less, and that according to the excess of the one above the other, is demonstrable from the most common Law of Nature; that every thing, forasmuch as it is simple and undivided, continues (as far as in it lies) always in the same state, neither is ever changed but by outward Causes. Now the state of the *Body* E, is *Rest*, and in the swifter *Body* A, the state is quite contrary, and that proportionably to the Excess of *swiftness*. For the slower the *motion* of A is, the less contrary is it to the state of the *Body* E, which is at *Rest*, because slowness of *motion* partakes of the Nature of *Rest*. Wherefore, if A with the greatest degree of *swiftness* be carried towards E, *Resting*, E will also have an absolute power of *Resisting*; and forasmuch as it resists, it will with a greater force of Action, resist the greater force that pusheth it, than a lesser.

If the *Body* at *Rest* E, be less than A, then tho' A move never so slowly towards E, it will carry it along, and communicate to it such a part of its *motion*,

XI.
The Fourth Rule.

XII.
A Body that is at Rest, doth more resist a greater Swiftness than a less.

XIII.
The Fifth Rule.

motion, as that both of them afterwards may move with the same swiftness. As for Example, If A be as big again as E, it will communicate to E the Third part of its *motion*, because that one Third part will move E, as swiftly as the Two remaining parts will move A, because it is as big again. And since whatsoever accrues to the one, is the loss of the other, it is necessary that after this meeting A move one Third part slower, than it did at first, that is, in the same time wherein before it run through the distance of three Foot, it will only move two Foot.

In like manner, if A were thrice as big as E, it would communicate the Fourth part of its *motion* to it. If it were four times bigger, it would impart a Fifth part of its *motion*; and so on. But if A should only a Third part exceed E, and consequently should have the Relation to it, not of Two to One, but of Three to Two, then two fifth parts of the *motion* will be transferr'd from A to E, and three Fifths will still continue in A. If E be one Fourth bigger, and have the same Relation to A, as Four to Three, three Seventh parts of its *motion* will be communicated to E, and so four Seventh parts will remain to A.

This account will be more evident, if we express the foresaid Fractions by whole Numbers: Saying, if A be to B, as 3 to 2, then of the five degrees, into which its *motion* may be distinguish'd, two must be communicated, which will have the same proportion to E, as the three remaining to A: And if A be as 4, and E as 3, out of the seven degrees of its *motion*, three must be communicated, which will have the same proportion to E, as the remaining 4 to A. And if A be to E as 5 to 4, of the 9 degrees into which its *motion* may be distinguish'd, 4 will be communicated, and will have the same Proportion to E, which the Five remaining have to A. And thus we may proceed to Infinity; for tho' the excess of Quantity in A, above that which is consider'd in E, does by this means grow less, yet it will always be something; and since we may always take so many degrees of *motion*, as there are parts considered in the Body moving and moved, taken together, we find no Reason why A should move E along with it, seeing the difference is of one Sixth, Seventh, Eighth, or even of a Hundredth or Thousandth part, and so on.

The account will proceed in the same manner, whether you reckon the Parts of Motion to be so many, as there are consider'd in the Bulk of both Bodies, viz. the Moving and Moved, or whether you attribute two, or three, or four Parts or Degrees, and so on, of *motion*, to every one of the Parts of Bodies; because the same Proportion will continue every where between the Motion that is communicated, and that which continues in the Mover. Thus we may say, that if A be one Third bigger than E, of the 10 parts into which its *motion* may be distinguish'd, 4 will be transmitted to E, the remaining 6 continuing with A: Or, if we suppose 15 parts of Motion, then 6 will be communicated and 9 will remain; if 20, the Body E being a Third part less than A, will receive 8 of them, and A will retain the other 12. For all these Numbers, 12 to 8, 9 to 6, 6 to 4, have the same Proportion together which they ought to have, which is 3 to 2; and therefore it is all one

which of them you take, and you may increase them to Infinity. And how slow soever you suppose the *motion* in A to be, it will still in the same proportion act upon E, that is, will always communicate to it only such a part of its *motion* as shall bear the same proportion to E, as the remaining part hath to A. And thus, if A be as big again, whether it be swiftly or slowly moved, it shall always transfer a Third part of its *motion* upon E; if thrice as big, only a Fourth, and so on.

If the Body E, Resting, be exactly equal to the Body A, moved towards it, it will partly be push'd forward by it, and partly beat it back to the opposite side. So that if A should come towards E, with four degrees of Swiftness, it would communicate to E one degree, and with the three remaining parts would rebound to the contrary side.

For seeing that both these Bodies are supposed of equal bigness, they must also have the self same Force of Acting and Resisting: Now this Force to Resist in E, is not only Negative, but Positive, or, if you will, Reactive; because E so admits the *motion* of the Agent A, as to cause some change in it, to wit, by Reflecting it, and communicating some part of its own Rest unto it. And by this means the Body E obtains the half of its effect. But the Body A, because of its inequality, transfers a part of its *motion* to E, not the whole; for so it would tend to its own destruction, by losing all its *motion*. Thus if the Body A should move towards E with four degrees, in meeting with the Body E, it would impart one degree to it, and would rebound back with the three remaining parts. If with eight degrees, it would impart two of them to the Body E, and rebound with the other six. If it mov'd forwards with twenty degrees, it would communicate five of them to E, and fly back with the remaining fifteen, and so both would obtain the half of that effect, the whole of which they would have, if either of them were greater or less.

Suppose we now the Bodies A and E, to move the same way, E more slowly, and A following it more swiftly, so as at last to overtake and touch it: Suppose we also E to be greater than A, but A to exceed in degrees of swiftness the Greatness of E; in this case A will communicate so much of its Motion, as that both of them afterwards shall move with an equal degree of swiftness the same way.

That A must overtake E, appears from the Supposition of its being mov'd more swiftly than E; and that it must act upon it, and push it on along with it self, is also evident, because upon examining the proportion of Magnitude and Swiftness that is between them, we find that the Excess of swiftness is greater in A, than the Excess of Greatness in E; and therefore by reason of the inequality of Action and Resistance, it must follow that A, by communicating some part of its *motion* to E, must push it forwards; and so both of them with the same swiftness move the same way.

But if the Excess of Swiftness be less in A, than the Excess of Greatness in E, it will rebound back, and retain all its *motion*. The Reason is, because that which is the stronger in Action and Resistance, must needs obtain its effect. Now seeing

XIV.
The Sixth
Rule.

XV.
The Seventh
Rule.

XVI.
The Eighth
Rule.

the Body E, by its Greatness or Bulk, exceeds the swiftness of A, and has more force to *Act* and *Resist*, it must push forwards the Body A, and make it rebound backwards. But forasmuch as every thing inclines to continue in its state, except it be hindered by an outward Cause, and this Cause is found in E, viz. an Excess of Magnitude, above the Excess of Swiftness in A, which changeth the determination of A, but doth not destroy or diminish the Motion it self, therefore it happens that A, by rebounding, loseth nothing at all of its own motion.

But if the Excess of Bulk be greater in E, than the Excess of Swiftness in A; that is, if E be as big again as A, and yet A be not moved with a double degree of swiftness; then when A comes to dash against E, it will reflect the contrary way, without communicating any thing of its motion. Lastly, if the Body E doth equally exceed A in Bigness, and that it be as big again, which is just as much as A exceeds E in swiftness, and therefore hath a motion, that is, as swift again, it will follow that A must communicate some part of that its swifter motion to E, and with the residue rebound back from it.

CHAP. VIII.

Of the Ptolomaick, Copernican, and Tycho-nick Systems of the World.

I.
What a
System is,
and how
many there
are.

A System in Natural Philosophy is that, whereby a thing acts after a certain manner, by virtue of its Composition, and those Dispositions which constitute its Nature. Thus we call the System of the World, the Order or Disposition wherein we conceive, that all we see in the World is performed, by supposing it to be compos'd of certain Parts, the Nature and Connexion whereof is such, that thence results whatsoever is, or is done in it. Amongst the Systems of the World, invented by Astronomers, there are Three more famous than the rest, viz. those of Ptolomy, Copernicus, and Tycho Brahe, to which all the rest that have been invented by the Ancients may be referr'd.

II.
The Ptol-
maick
System.

Figure
16.

PTOLOMY placeth the Globe of Earth and Water in the Center of the World, and supposeth it destitute of all motion. Next to the Earth, he placeth the Air mingled with Vapours and Exhalations, which raising it self only a few Miles above the Earth, is called the Atmosphere. Next below the Moon he placeth his Element of Fire; the several Spaces above which he divides into Eleven Spheres, in the first Seven whereof he ranks the Planets: In the first ♄, the Moon; in the second ♀, Mercury; in the third ♀, Venus; in the fourth ☉, the Sun; in the fifth ♂, Mars; in the sixth ♃, Jupiter; in the seventh ♄, Saturn; which he calls Wandering Stars: Not that they wander at Random; but because they are carried with an unequal motion within the Zodiac, so as not to keep the same Distance from one another, if compar'd with the fix'd Stars. In the Eighth Sphere he placeth the Firmament, in which the fix'd Stars are supposed to be fastned.

After these follow two other Spheres, which he calls Crystalline, or the Heavens of Libration and Trepidation; the first Moving from the East to the West, the other from the North to the South.

The Eleventh and highest Sphere he calls the *Primum Mobile*, or *First moved*. This Description of the World is by the Common People generally approved and maintain'd; who look upon the Heaven as a Vaulted Roof, equally distant from us, who are as in the Center, and suppose all the Stars that appear in it, to be in the said Circumference of the World.

NICOLAUS COPERNICUS, a Physician of Thorn, and Canon of Frassenburg, who flourish'd not much above an hundred years since, introduced another System in Imitation of the Pythagoreans, who attributed a motion to the Earth, and plac'd the Sun as the Soul of the World, in the Center of it; and consequently assigns the same place to the Earth, which Ptolomy allows the Sun, that is, betwixt the Planets Venus and Mars. The Earth, according to Copernicus, hath two motions; the one Diurnal, which in 24 Hours space is performed about its own Axis, from West to East; which Motion makes Days and Nights, as shall be said hereafter. And this Motion performs the same Service, which the *Primum mobile* doth in the Ptolomaick System, to wit, by effecting that all the Stars seem to move from East to West; much in the same manner as a Ship, which sailing from the Shoar, or towards it, makes the Shoar it self seem, as if it drew near, or withdrew from the Ship. The other Motion of the Earth, is its Annual motion, by which she is carried about the Sun, from the West also to the East, according to the Succession of the Signs of the Zodiac; by which means, the Sun which stands immovable in the Center of the World, doth seem to run through those Signs, tho' indeed it is the Earth only that truly doth so. And whereas the Space that is between Mars and Venus, is large enough for the Moon to be carried round between them, she accordingly performs there two Motions, the one Monthly, wherewith she is whirl'd about the Center of the Earth, and appears in her several Changes; the other Yearly, whereby (together with the Earth) she goes round the Sun.

Wherefore, according to the Copernican System, the Sun is placed in the Center of the World immovable. Tho' this hinders not, but that it may be carried round about its own Axis within the space of 27 days, which that it is, appears by the turning round of its Spots, discovered by the Telescope. Next to the Sun, Mercury is whirl'd about; in the second place, Venus; in the third, the Earth, together with the Moon its Attendant; in the fourth, Mars; in the fifth, Jupiter; and in the last, Saturn. After which follows the Region of the fix'd Stars, so called, not because they are without all motion, but because they do not wander up and down like the Planets, but continue in their own places, and keep the same distance from one another, as will be shewed in the XXth Chapter of this Part.

Besides these two Systems, a Third hath been contrived by TYCHO BRAHE, which partakes of both the foregoing Systems. For as to the Digestion of the Parts of the World, it agrees with the Copernican, save only in this, that it constitutes the Earth to be the Center of the Firmament, and accordingly makes the Moon and Sun to run round it. Thus in explaining the seeming motion of the Heaven, which seems to be performed in

III.
The System
of Coper-
nicus.

Figure
17.

IV.
The System
of Tycho
Brahe.

Figure
18.

in 24 Hours, he follows *Ptolomy*, and supposeth the *Earth* to stand immov'd in the *Center*, and the whole *Heaven* to be carried round it, from *East* to *West*, by the Force of the *Primum Mobile*. But in explaining the Appearances of the *Planets*, he agrees with *Copernicus*; making *Mercury* and *Venus* to be carried round nearest to the *Sun*, as their *Center*; but *Mars*, *Jupiter* and *Saturn* at a farther distance; and in the middle Space placeth the *Earth*, with the *Moon* that is carried round her, in the same time that *Copernicus* assigns to it. The *Tychonick System* has this peculiar to it self, that the *Planets*, which perform their own motions about the *Sun*, are whirl'd about by it, so as that *Mercury* and *Venus*, in their Turnings round about the *Sun*, do never take in the *Earth*, as *Mars*, *Jupiter*, and *Saturn* do. So that as *Gassendus* observes, If instead of the *Sun's* whirling about together with *Mercury* and *Venus*, who exclude the *Earth* from the compass they take, and with *Mars*, *Jupiter* and *Saturn* enclosing it, the *Earth* had been suppos'd to be whirl'd about with the *Moon*, comprehending in its compass *Venus* and *Mercury*, but comprehended within the compass of *Mars*, *Jupiter* and *Saturn*, it would come to the same thing; and *Tycho's System* would appear to be nothing else but the *Copernican* inverted.

V. Having given this brief Description of these three Systems, we are next to examine which of them appears the Truest. For seeing that they all differ, and that the Structure or Disposition of the Parts of the World is but one only, we must reject two of them as false, and choose the third as the truest. And tho' we should suppose nothing of Contradiction to be found in any of these Three, yet ought we to pitch upon that as the best, which appears the most simple, and supposeth least particulars.

VI. Wherefore we cannot admit of the *Ptolomaick System*, as being contrary both to Reason and Experience: To Experience first, with regard to the appearances of *Venus* and *Mercury*, seeing it is evident that these Planets are not always whirl'd about on this side of the *Sun*, as *Ptolomy* supposeth, but sometimes appear above, and sometimes beneath, yea, and sometimes also side-ways to it; so as that sometimes they are nearer to, and at other times they are further from us than the *Sun*. For this Cause *Copernicus* took occasion from the various appearance of *Mars*, to assign motion to the *Earth*. For he perceiving that *Mars*, whilst he is opposite to the *Sun*, appears much greater; and that he grows less, as he nearer approacheth to it, could not attribute this change to any thing better, than to the Circumrotation of the *Earth*: According to which, it was necessary for *Mars* to appear biggest, when the *Earth* moves nearest to him; and least, when the *Earth* leaves him on the other side of the *Sun*.

Secondly, Pursuant to this System, no Reason can be given why *Mars*, *Jupiter* and *Saturn* are always in the lower part of their *Epicycles*, when they are *Retrograde*. Whence it is that the *Moon* doth always turn the same part of her Body towards us: Why *Saturn* appears in a various shape to us, sometimes *Oval*, and at others *Round*, when beheld through a *Prospective*.

Thirdly, This Hypothesis doth not explain the

contrary Motions, whereby the Stars at the same time seem to move from *East* to *West*, and from *West* to *East*.

Fourthly, Neither can the rise of Comets, nor their motions, be solved, as long as we suppose the Heavens to be solid, as he doth.

Fifthly, According to this Hypothesis we cannot give any account, how the Spots about the Sun are generated, and afterwards dissipated; nor how they can perform their Circuits about the Sun.

This System is also contrary to Reason, by allowing the motions of Trepidation and Libration to the Crystalline Heavens. For what is more misbecoming a Philosopher, than for the extricating of a lesser Change, to admit a far greater? For a Body that is carried towards one Point, tho' by an uneven motion, unquestionably doth not undergo so great a Change, as another, which is also carried towards one Point, and suddenly rebounds to the opposite Point. To this may be added, that it was in vain that the Ancients had recourse to this motion, for the explaining of the Equal progress of the fix'd Stars; since the most exact Astronomers frequently Experience, that what they deduce thence by their Computations, doth not correspond with the Phenomena. Besides, the Motion of the Heavenly Orbs will be swifter than can be competent to such vast Bodies, and more especially to the Brittle Crystalline Spheres; for the utmost Sphere of the World must be whirl'd about in 24 Hours. Moreover, what is more improbable than that the *Primum Mobile* should have the force to carry round with it all the Inferiour Orbs, from *East* to *West*; and yet that the *Earth*, which is included in them, should remain unmov'd? When yet, according to *Ptolomy*, the *Earth* is altogether Passive, and is encompass'd with the subtil Matter. These Absurdities are sufficient to make us reject this *Ptolomaick Hypothesis*.

Tho' the *Tychonick Hypothesis* seem more probable than the *Ptolomaick*, forasmuch as it gives an account of the Inequality and Diversity of the Celestial Appearances, yet is it not without its obscurity and defects. For it seems in a manner to disjoyn the whole System of the World, forasmuch as whilst the *Sun* (the Center of Five of the Planets) whirls about the *Earth* in its Annual motion, this his Annual motion is entangled with the proper motions of the several Planets; for the explaining whereof he is fain to make use of a Circle, describ'd from the *Sun's* Center with two *Epicycles*; whereas the structure of the World, is without doubt very far from any intricacy or confusion, and allows every Planet a sufficient Space to run its Course in.

Besides, this System hath several other Defects for which it is to be rejected, as well as the *Ptolomaick*. For tho' it admits of less Suppositions for explication of the Motion of the Planets, and gives a plausible account of the Appearances of *Venus*; yet it cannot be deny'd, but that it requireth something, which the Mind of Man can hardly assent to, in that it supposeth that Motion, whereby the Mass, consisting of the Heavens and Planets, in Twelve Months time, moves towards all parts of the Firmament. For tho' we should admit, that it had been put into such a motion by the Author of Nature, at the beginning of the Creation; yet withal

VII. This Hypothesis is likewise contrary to Reason.

VIII. The Tychonick system also hath its Errors.

IX. And is to be rejected, as well as the Ptolomaick.

Ptolomy's System rejected.

VI. Many things are amiss in the Ptolomaick System, as being contrary to Experience.

withal we must suppose, that according to the *Laws of Nature*, which GOD himself hath established, the said *Motion*, in success of *Time*, must be diminished, and at last cease altogether; since (according to the same) it must have been communicated to the *Heavenly matter*, which the fore said *Mass*, to which *BRAHE* assigns this *Motion*, drives from those *Parts* to which it tends.

X.
The Copernican System is to be preferred before the two former.

It remains therefore, that we only admit of the *Copernican System*, as being both more plain and simple than the two foregoing, and solving the *Phænomena* of the *Heaven* the best of the three. But forasmuch as *Des Cartes* professeth himself to dissent from *COPERNICUS* and *TYCHO* as to the *Motion* of the *Earth*, which he denies with more *Truth* than *TYCHO*, and with more *curiosity* than *COPERNICUS*, we intend last of all to propound his *Scheme*, as the only true one.

CHAP. IX.

Of the true Systeme of the Universe.

I.
The Copernico-Cartesian Hypothesis explained.

Figure 19.

DES Cartes supposeth that *Matter* indefinitely extended, and by *motion* imprest upon it, divided into various *Particles*, did run together into several *Vortexes* or Whirl-Pools, whirling about some certain *Points* with a most swift *motion*; that the more subtil matter gathered together about the *Center* of these *Vortices*, constitutes the *fixt Star*; that the matter which is a degree bigger, makes the *Heavens*; and that the more solid *Bodies* (such as is the *Earth* and the rest of the *Planets*) hanging poised in this fluid matter, comply with the *motion* of the *Vortex* about the *fixt Star*, and may over and above this, be whirled about their own *Axis*; as we often see that *Bodies*, carried in a fluid *Stream*, are turn'd round by a *motion* of their own, that is, proper to themselves, and not derived from the *Stream* wherein they are carried.

II.
The first Heaven.

Moreover *Des Cartes* divides all the *Vortexes*, that compose this *World* into two *Heavens*. In the first, he supposeth all the *Matter* of *Heaven* in which the *Planets* move, to run round continually in manner of a great *Vortex*, or mass of fluid *Matter* whirling round, in the *Center* whereof is the *Sun*, S, and that those *Parts* that are nearer to the *Sun*, move more swiftly, than those that are more remote, and that all the *Planets* (of whose number also the *Earth* T is,) have their course continually amidst the *Parts* of that *Celestial* *Matter*.

III.
The second Heaven.

The second *Heaven* comprehends an immense number of other *Vortexes*, which surround this *Vortex* or first *Heaven* A, B, C, which in their *Centers* have the several *fixt Stars*. And because we are uncertain at how great a distance the *fixt Stars* are from us, and cannot conceive them so remote as to contradict the *Phænomena*, we will not content our selves with placing them above *Saturn*, but will take the liberty to conceive them much higher; seeing that it is apparent from the *Celestial* *motions*, that they are so far distant from us, that *Saturn* compar'd to them, seems to be very near us. *Des Cartes* to illustrate the *Truth* the more about the *motion* of the *Planets*, and especially of the *Comets*, made no difficulty to assign an immense distance between *Saturn* and the *fixt Stars*.

Neither is this in the least contrary to Reason, forasmuch as we know that *Mercury* is above two hundred *Diameters* of the *Earth* distant from the *Sun*; *Venus* above Four hundred; *Mars* Nine hundred or a Thousand; *Jupiter* above Three thousand, and *Saturn* Five or Six thousand. And proportionably we may extend the *Space* between *Saturn* and the *fixt Stars*, to any distance how vast soever. For tho' the *Region* of the *fixt Stars*, be commonly reputed the utmost Bounds of the *World*, yet its *Figure* cannot be certainly determined by us, seeing we can perceive nothing of its *Internal* nor *External Superficies*.

IV.
The distance of the fixt Stars from the Sun.

The first of the *Planets* and nearest to the *fixt Stars* is *Saturn*, who sometimes appears as if he had three *Bodies*, sometimes *Long* or *Tall*, sometimes *Spherical*, sometimes *Oval*, with *Ears* and *Ear-rings*. For tho' *Saturn* like the other *Stars*, be of a *Round Figure*, yet is he surrounded with a broad *Circle* or *Ring*; standing at an equal distance from him; the proportion of the *Semidiameter* of the *Planet*, being to the distance of the *Ring*, as 3 to 5: but the entire *Diameter* of the *Ring*, to that of *Saturn* is about the proportion of 11 to 5. The *Ring* is thin, but broad, and if continued, would pass through the *Center* of *Saturn*. This *Planet* being most remote from the *Sun*, the *Center* of this our *World*, and being moved in a large *Vortex*, is almost 30 years in finishing his *Circuit* in our *Heaven* ABC.

V.
Saturn is the first of the Planets.

Three *Satellites* or *Guards*, are observed to move about him, the *First* whereof is distant from the *Center* of *Saturn*, one *Diameter* of the fore said *Ring*, and performs his *Circuit* about *Saturn* in the *Space* of 4 days, 12 hours and 27 minutes. He is seen through a *Telescope* of 35 Foot, in his furthest digression from *Saturn*, but is imperceptible when nearer to him. The *Second* is much more illustrious, and may be descried by any moderate *Telescope*, and is distant from *Saturn* four *Diameters* of the said *Ring*, and whirls round him in the time of 16 days and 23 hours. The *Third* is distant from him 10 *Diameters* of the *Ring*, and performs his *Circumvolution* in the *Space* of about 80 days.

VI.
Saturns three Satellites.

The next to *Saturn* is *Jupiter*, who absolveth his *Course* in almost 12 years. He hath four less *Planets*, as so many little *Moons* to be his *Companions*, to which *GALILEÆUS* gave the name of the *Medicean Stars*, because he first discovered them in the *Dominions* of the Duke of Florence. Their special names are, the *Jovial Saturn*, *Europa*, *Ganymedes*, *Calisto*; whereof the *First* or remotest wheels about *Jupiter* in 16 days; the *Second* in 7 Days; the *Third* in 85 hours, and the *Fourth* in 42 hours.

VII.
The Second is Jupiter.

The Third *Planet* *Mars* is carried about a in greater *Vortex* than the *Earth*, and in a less than *Jupiter*; and finisheth his *Revolution* in near two years. In the midst of this *Planet* *CAMPANELLA* by the help of *Prospectives* discovered a *Black Mountain*, higher than the *Mountains* of the *Moon*: From whence, as likewise from the *Spots*, wherewith his *Face* is sprinkled, *CASSINUS* gathered, that *Mars* was whirled about his own *Center* in the *Space* of 24 hours and 49 minutes. There is also a round *Ring* somewhat resembling a *Rainbow*, but of a Redder Colour, which surrounds the *Foot* of that *Mountain*.

VIII.
The Third is Mars.

The

IX.
The Fourth
is the Earth

The fourth place is taken up by the *Earth*, which absolvs its Course together with the *Moon*, (which she carries about in her *Vortex*) within the Space of a Natural year. All the Matter that reacheth from the *Earth* to the *Moon*, is called *Elementary Matter*; and because this Matter contains many parts, which are moved more swiftly than the *Rest*, it follows that they must all of them be unequally determined to recede from the *Center* of their *Motion*, and that those which are more swiftly moved, withdrawing themselves with greater force, do by this means thrust the other parts downwards: Which is the cause of *Gravitation*, as hath been said before.

X.
The Earth
is not placed
in the
Center of
the World

Now that the *Earth* is not placed in the *Center* of the *World*, but rather is as far distant from the *Center*, as from the *Sun*, appears from hence; that all the *Planets* are sometimes nearer, and at other times farther from the *Earth*; and that with such a vast difference, that *Venus* when she is farthest from us, is at a six-fold greater distance, than when she is nearest; and *Mars* is eight times farther distant in the one State, than in the other, which could never be, if the *Earth* were the *Center* of the *World*.

XI.
The Fifth
is Venus.

The Fifth is *Venus*, who runs her course in 224 days. She is carried below the *Earth*, surrounding the *Sun*, which may be concluded from the changes of her *Figure* and appearance, proceeding from the *Illumination* thereof.

XII.
The Sixth
is Mercury.

Next to *Venus* is *Mercury*, finishing his Course about the *Sun* S in the Space of 80 days, or as others will have it in 87. He very rarely appears, being for the most part obscur'd by the *Sun's* Rayes. Hence *GALILAEUS* conceives, that *Saturn* for his slowness, and *Mercury*, for his almost continual occultation, ought to be accounted the last of the *Planets*. Now forasmuch as *Mercury* doth not appear, but in his farthest *Elongation* from the *Sun*, he is seldom seen *Round* through a *Telescope*; but sometimes as it were cut in two, as the *Moon* in her *Quarters*, sometimes more *Gibbous*, and at other times hollow; and being nearest unto the *Horizon*, and obscur'd by *Vapours*, its *Figure* or *Bulk* can scarcely be discovered.

XIII.
The Sun is
the Center
of the
whole com-
pact of the
Heavenly
Matter.

In the midst of this great *Vortex* the *Sun* is placed, as in the *Center* of the *World* unmoved, and like a *Prince* seated in his *Royal Throne*, illustrating all the *Bodies* about him, both *Cherishing*, and *Quickning* them with his *Heat*. *TRISMEGISTUS* calls him the *Visible God*, and *SOPHOCLES* gives him the Epithet of *Beholding all things*. But notwithstanding what we have said of his being unmoved, he may whirl about his own *Axis*, in the of Space of 24. days, which *Astronomers* conclude from the most constant *Motion* of its *Spots*.

XIV.
All the
Planets
are moved
from West
to East.

Tho' all the *Planets* with regard to their different *Degrees* of *Solidity* be unequally distant from the *Sun*, the *Center* of our *Vortex*, A, B, C; yet is this common to them all, that they perform their *Periodical Motions* after the same manner, viz. from *West* to *East*, or from A, through B, towards C, according to the succession of the *Signs* of the *Zodiack*. Save only that the *Earth* is carried with a threefold *Motion*, and as the chiefest *Star* amongst the *Planets*, hath the *Moon* for her *Attendant*: So that the *Vortex*, which hath the *Earth* for its *Center*, carries the *Moon* about the

Earth in a Months Space, the *Earth* it self being whirld about every day, round its own *Axis*. Thus in the same time, that the *Earth* and *Moon* finish their *Common Circle*, or *Great Orb* once, the *Earth* is 665 times whirld about its own *Axis*, and the *Moon* twelve times carried about the *Earth*.

The Common *Objection* against this *Hypothesis* is, that the *Horizon* in all parts of the *World*, divides all the great *Circles* into equal *Parts*, so that always one half of the *Equinoctial* is above it, and the other half under it, and consequently always 6 *Signs* of the *Zodiack* above the *Horizon* and as many under it; whence it must follow, that the *Earth* is in the *Center* of the *World*, and not the *Sun*.

To which I answer, that this proves indeed, that the *Earth* is in the midst of all the great *Circles* of the *Sphere*, but not that she is in the *Center* of the *World*, because it is our *Imagination* only, that represents these *Circles* about the *Earth*. Accordingly it would be a false consequence to say, that the *Earth* is in the *Center* of the *World*, because the *Parts* and *Degrees* of the *Earth*, do correspond proportionably to the *Parts* and *Degrees* of *Heaven*; for on the contrary it follows that these *Circles* are equally distant and proportional in their *Parts*, with regard to the *Earth*, seeing that it is our *Imagination* which conceives them round its *Center*.

Notwithstanding the *Earth* and all the other *Planets* be carried by the *Celestial matter* that surrounds them from *West* to *East*, yet they may more properly be said to *Rest* than to *move*. For seeing that *Local motion* is nothing else but the *Translation* of one *Body*, from the *Neighbourhood* of those *Bodies*, which immediately touch it, and are considered as *immoveable*, into the *Neighbourhood* of other *Bodies*, and that neither the *Earth*, nor any of the other *Planets*, are translated from the *Neighbourhood* of those parts of *Heaven* that immediately touch it, and are lookt upon as *immoveable*, the *Earth* and *Planets* according to the *Truth* of the thing are not moved, that is, have no motion properly so called.

Yea, if we give head to the *Definition* of *motion* we shall easily discern, that that which we call the *Diurnal motion* doth not belong to the *Earth*, by it self considered, but as it is an *Aggregate* of *Earth*, *Seas* and *Air*, seeing it is to be lookt upon at altogether at *Rest*, whilst it is whirld about by the stream of the *Heavenly matter* wherein it swims; like as a *Man* who sleeps in a *Ship*, is said to *Rest*, whilst the *Ship* is carried from one place to another. We shall also perceive, that the *Annual motion* of the *Earth*, whereby it is carried about the *Sun* from *West* to *East*, through the *Signs* of the *Zodiack*, cannot be ascribed to her, but to the *Celestial matter*, which carries this vast *Mass* round the *Sun*.

Moreover we are to mind that the *Circuits* the *Planets* make about the *Sun*, are not perfectly *Circular*: For as we see that in some parts of *Rivers*, where the *Water* whirling about, makes a *Vortex*, and carry many *Straws* along with it, some of them at the same time are whirld round about their own *Centers*, and are moved more swiftly as they are nearer to the *Center*; and tho' they incline to move *Circularly*, yet do not always describe exact *Circles*;

XV.
An Obje-
ction an-
swered.

XVI.
The Pla-
nets may
more pro-
perly be
said to Rest
in their
Vortex
than to be
moved.

XVII.
Neither
the Diur-
nal nor
Annual
Motion do
properly
belong to
the Earth.

XVIII.
The Orbs
of the Pla-
nets are
not exactly
Circular.

cles; so we may without difficulty imagine all the same things concerning the Planets. As is manifest from their nearer and further distances from the Sun, and from their Descent and Ascent in the Zodiac, being sometimes above the *Ecliptical Line*, and at other times under it.

CHAP. X.

That the Heavens are Fluid Bodies.

I.
It is no difficult matter to know the Nature of the Heavens.

IT will not be difficult to have a certain knowledge of the Nature of the Heavens, if we consider that the Matter whereof they consist, is the same with that of the *Inferiour World*, nothing being to be found in it besides *Divisions, Figures, Magnitudes and Motions*. Which Modifications, whereforever they are, still cause the same changes. And therefore we are to *Philosophize* concerning the Heavens no otherwise, than of our Bodies here below.

II.
The distinction of Hard and Fluid Bodies.

We are therefore to suppose that Bodies are either *Hard or Fluid*. *Hard* are those whose parts are so joyned, as not to be separable from one another without difficulty. Whereas *Fluid* are such whose Parts do readily give way: But how it comes to pass, that some Bodies do easily give way to others, and that others are not removed from their places without Force and Difficulty, we shall easily apprehend, if we consider, that these things which are moved, do not hinder other Bodies from entering their places; whereas those that are at Rest, are not without some force pushed out of them.

III.
The Parts of Hard Bodies are at Rest, and those of Fluid, in motion.

Whence it follows, that those Bodies are *Fluid* whose parts are tossed with various Motions; and those *Hard*, whose Parts being closely joyned together are at Rest. And tho' it may be our Sense may not perceive the parts of *Fluid Bodies* to be moved, yet are not we therefore to deny it; because we see the *Water* and *Air* do corrupt solid Bodies, which cannot be done without Motion.

IV.
The Heavens are no Solid or Hard Bodies.

We say therefore, that the Heavens are no *Hard or Solid Bodies*, but *Fluid*. For if they were *Hard*, they could not transmit the *Light* of the Stars: For *Hard and Diaphanous Bodies*, transmit the *Light* because their Pores are rang'd in *Right Lines*, which could never be, if the vast Bulk of the Heavens was *Solid like Crystal*, or did much infringe the *Light*, as we see, that when many pieces of the clearest *Glass*, are laid one upon one another, they become very opaque.

V.
Supposing that the Heavens were Solid, the superior Spheres, could not carry the inferior along with them.

If the Heavens were *Hard*, we could never explain how the *Lower Heaven* should be snatch'd along by the *Heaven* above it; as the *Peripateticks* imagin. For how can the *Heavenly Orbs*, supposed polish'd and even, hurry away with their Motion the *Spheres* that are under them? Yea when the *Sun* and the rest of the *Planets*, are whirl'd about round their Center, as hereafter shall be declared, no reason can be assign'd, why they should not as well be carried in the *Liquid Ether*. And indeed all the *Antient Philosophers*, before *ARISTOTLE*, were of Opinion that the Stars moved in the Heavens like *Fishes* in the *Sea*. And *Astronomers* are of the same Mind, who have observed that *Mercury* and *Venus* have sometimes got above *Mars*, and come down again, which could never be if the Heavens they move in were *Solid*.

The same may be evinc'd by the *Comets* which are found to be above the *Region of the Moon*, and to slide through those *Aethereal Spaces*, which could not be without those Spaces were filled with a *Fluid Body*. The *Astronomers* have also observed, that the *Medicean Stars*, do roul about *Jupiter*, as *Venus* about the *Sun*, which likewise proves the Fluidity of the Heavens.

Neither only are those *Heavens Fluid*, which contain *Mercury, Venus, Mars, Jupiter, Saturn*, and our *Earth*, together with the *Moon* its Companion, but the Matter of the *Sun* it self is also *Fluid*, and is continually whirl'd about its own *Axis*, as is evidenced from the Motion of the Spots about the Body of the *Sun*; for they are not generated in the *Air*, as some have supposed, but in the very Body of the *Sun*. For at first they are seen in the midst of the *Sun's Body*, and near to his *Ecliptick*, and never towards the *Poles* of the *Solar Body*. This is confirmed by many *Astronomers*, who at great distances of Place, have observed the very same Spots, at the same time, and in the same places. Now that the *Sun* doth not only move these Spots, but also the *Planets* that are about him, appears from hence, that the nearer any *Planet* is to the Body of the *Sun*, the swifter it is turn'd about. And the same is to be conceived concerning that vast Space, which is found about every *fixt Star*.

But you'll say first, that the *fixt Stars* observe the same distance from one another, which could not be if they wander'd in a *Fluid Heaven*, changing their places, as is evident concerning the *Planets*, who oft enter one anothers Orbs. I answer, that the equal distance the Stars keep, doth not prove the Solidity of the Heavens, but that they possess some determinate Orbs. For the *fixt Stars* are not placed in the Circumference of one Sphere as some imagin, but every one of them hath its own Space or Orb; and because they observe the same Order and Proportion amongst themselves, therefore are they called *Fixed*.

In the Second place you'll say, If we suppose the Heavens to be *Fluid*, it cannot be conceived how *Solid Bodies* can be carried about in them, seeing that they have not so much Power, but do readily give way to *Hard Bodies*. And indeed what likelihood is there that, that which is *Hard and Solid*, should be hurried along by that which is *Fluid and Weak*? I answer, that it must indeed be confessed, that *Fluid Bodies* are not of so great force, as those that are *Solid*, to hinder the motions of other Bodies; for seeing they having a motion themselves, and that motion is not contrary to motion, they do not resist them so much as *Solid Bodies*. But for all this it cannot be denied, but that the motion of Fluids where determin'd one way, doth carry all *Hard Bodies*, along with it. As appears in a *Stone*, which the *Water* of the *River* carries along with it, so long as it is not detained by some *External Cause*. And therefore there is good ground why the *Globe* of our *Earth*, resting in the pure *Ether*, should easily be carried about by its *Heaven*. In like manner as we see *Straws* on the surface of the *Water* carried about by the whirling round of the *Water*, whilst some of them whirl at the same time about their own Centers, being all of them moved the swifter, by how much the nearer they are to the Center of the said Whirlle pool.

VI.
The Motion of the Comets and Stars, is a pregnant proof of the Fluidity of the Heavens.

VII.
The Fluidity of the Heaven proved by the Spots of the Sun.

VIII.
How the fixt Stars keep the same distance from one another.

IX.
Fluid Bodies have the Force to carry Solid Bodies along with them.

The

X.
A Hard
Body, how
great soe-
ver it is,
resting in
a Fluid,
will be mo-
ved by the
least force.

The Reason whereof is, because a *Hard Body* encompass'd with a *Fluid*, and Resting in it, lies there as in an Equal Poise; and how great soever it may be, will be easily carried away by a little force, whether that Force come from abroad, or that the *fluid Body* it self, wherein it is contain'd, be wholly carried one way; as the Course of *Rivers* tends towards the *Sea*; or as the *Air*, when the *East-Wind* blows, is carried towards the *West*; which whenever it happens, any *hard Body* that is in that *fluid*, must of necessity be carried along with it.

XI.
The Hea-
ven hin-
ders the
Earth from
Falling.

Hence we may infer, that seeing the *Heaven* doth on all sides surround the *Earth*, and drive all the *Bodies*, that are on the surface of it, towards its *Center*, it doth by this means keep it from Falling: So that the *Earth* cannot but be carried along by it, and being thus without any *motion* of its own, yielding only to that of the *Heavens*, it may with good reason be said, to be at Rest. And the same may be said of the *Sun*, who is hindered by the *Globuli* of the *Second Element*, which surround him, from flying from the *Center*; and the lower *Globuli*, by those above them; and the utmost, by those of the contiguous *Vortexes* of the *fix'd Stars*, who by a contrary pressure do keep them within their Bounds.

CHAP. XI.

How the Heavens were disposed at first, and of their divers Motions.

I.
Three
things are
to be sup-
pos'd here.

IT will not be difficult to demonstrate the first *Disposition* of the *Heavens*, or that order which the *Heavenly Orbs* now observe, and did from the Beginning, by supposing only a few things, which we have proved in the *Fourth Part*.

II.
The First.

First, That there is no *Vacuum* in *Nature*; for seeing that *Space* is not distinct from a *Body*, it must necessarily follow, that wheresoever *Space* is found, there must be a *Body* also.

III.
The Second.

That there can be no penetration of *Dimensions*; for seeing that the Conception of a *Body* involves *Extension*, and by it excludes all other *Bodies* out of the same place with it, it is evident that many *Bodies* cannot be contain'd in the same place.

IV.
The Third.

Whatsoever is moved, is moved in a *Circle*; for seeing all places are fill'd with *Bodies*, it is clear, that one *Body* cannot be removed out of the *Neighbourhood* of some *Bodies*, into the *Neighbourhood* of others, without being mov'd in a *Circle*. So that when any *Body* enters into a place, the *Body* that was there before leaves it, and enters into the place of the next, and so on to the last; which at the same instant of time enters into the place the first *Body* hath left.

V.
What we
are to un-
derstand by
the words
Vortex,
Center,
Ecliptick,
Poles and
Axis.

It will not be amiss for us also to explain what we intend by the Words, *Vortex*, *Center*, *Ecliptick*, *Poles* and *Axis*. By the word *VORTEX* we understand, a vast number of parts of *Matter*, which move together about the same *Center*. By the *Center* of a *Vortex* we mean, the point about which all the parts of *Matter* that constitute the *Vortex* do move. And because when a *Vortex* turns round, all the Points of the *Surface* describe *Crooked lines*, which resemble *Circles*, except two that turn about themselves, we call those two Points the *POLES*; and the *Circle*, which is

equally distant from the two *Poles*, we call the *ECLIPTICK*; and the *Right line*, which reacheth from one *Pole* to the other, passing through the *Center* of the *Vortex*, we call the *AXIS*.

These things premis'd, we say that the Parts of the *Universe*, being in the Beginning of the *Creation* put into *motion*, must naturally run themselves into several *Vortexes*; for these *Particles* being of different bulk and figure, and unable to move forwards in *Right lines*, because of their various determination, they were forced to move in *Circles*, and by this means did constitute *Vortexes* of a stupendous Magnitude, according to the Quantity of the *Matter*. For it is an unquestion'd Truth amongst *Philosophers*, that a *Body* which is dash'd against another, must of necessity rebound back from it, and so be carried in a *Circle*, that it may continue its *motion*, which may be proved by many Experiments. For the *Vortexes* of the *Air*, or those of the *Water*, which we see in *Rivers*, are caused, because the *Vapours* that make the *Wind*, and the running *Waters*, being beat back by occurring *Bodies*, are hindered from moving strait forwards: and therefore being reflected on one side, must necessarily turn round, because the subsequent *Air*, or *Water*, is successively push'd forwards after the same manner as the first, and so must twist in and be carried Circularly.

VI.
How the
Vortexes
came first
to be.

That this was the Original of the *Vortexes* is unquestionable, by those who admit the *Matter* of the *World* to have been divided into particles of different Magnitude and Figure; and that they had as much *motion* from the beginning, as there is now found in the whole *Universe*. Because these *Particles* dashing one against another, must needs be carried round about divers *Points*, and so run together into divers *Vortexes*. So that all the *Particles* that were whirl'd about the *Sun S*, did constitute the *Vortex*, terminated by A, Y B, M, and that others which rould about the *fix'd Stars* L, C, O, K, compos'd other *Vortexes*.

VII.
The Divi-
sibility of
Matter
being sup-
pos'd, the
Vortexes
could not
but be
made this
way.

Figure
20.

We admit only two visible *Heavens*; the first, that whose *Center* the *Sun S* is, in which we live, and wherein *Venus*, *Mercury*, the *Earth* and the rest of the *Planets* are contained, and in which they are rould about with various motions. And the *Second Heaven* is that which contains innumerable *Vortexes* Z L Z, M C M, Y O Y, T K T, which have *fix'd Stars* in their several *Centers*, and on every side surround the *First Heaven S*. Whatsoever reacheth beyond these *Heavens*, does not fall under our Senses, tho' we conceive it Immenſe, and not confin'd within any Limits, being therefore called an *Expansion* or *Firmament*, from its vast and Indefinite Extension.

VIII.
That there
are but
two visible
Heavens.

The Disposition therefore, and ordering of the several *Bodies* of this *World* was made, when the *Planets*, and all other *Bodies* that lay confounded together in the *Chaos*, were separated by the subtil *Matter* flowing between them, and got into several places, according to the thickness and solidity of the *Matter*. Whence it is evident, that the Forms of the *Vortexes*, are the very first and most simple Forms that were ever introduced into the *Matter*; they are the *First*, because they are the immediate product of the *Laws* of *Motion*; and the most Simple, because they suppose none before them; and because all other Forms depend on them, as on their Principles.

IX.
How the
Vortexes
came to be
divided,
and what
the Form
of them is.

There

X.
How these
Vortexes
can per-
form their
Motions
without
hindring
one ano-
ther.

There is one Difficulty seems to arise from the Disposition of these *Great Bodies*, viz. how these *Vortexes* could fall into such a *motion*, as that one should not hinder the other: For it is hard to conceive how *Bodies* of so great a Bulk should not interfere with one another in their Circumvolution, seeing that according to the *Laws of Nature*, the *motion* of one *Body* is turned aside by the meeting of another.

XI.
The Diffi-
culty an-
swer'd.

This Difficulty may be answer'd by shewing, that these *Vortexes* may be so placed, that their *Motions* will rather further than hinder each other; that is, if we conceive them so ranged, that the *Ecliptick* of one, (or that part of the *Vortex*, which whirling about its *Axis* describes the largest *Circle*) do correspond to the *Poles* of the other: For by this means they will so agree together, and move so freely, as not in the least to hinder one another.

XII.
The Vor-
texes must
be so dis-
posed, as
that the
Poles of
one Vortex
may touch
the Eclip-
tick of
another.

Yea, if we examin the matter, we shall find that the *Heavenly Vortexes* cannot be so, but that the *Poles* of one must touch the *Ecliptick* of another. As suppose the first *Vortex*, whose *Center* is S, be moved from A, toward Y; another *Vortex* contiguous to it, whose *Center* is O, and another whose *Center* is C, must touch it in those *Parts* that are most remote from both the *Poles* A and B, of the *Vortex* S. For if we should suppose the *Poles* of two *Vortexes* to touch one another, they will either by a like determination of *motion* be carried the same way, and so will run one into another; or they must by a different determination be carried oppositely to one another, and so clashing in their *motions*, they will never be able to continue them long; and therefore to the end their *Motions* may not interfere together, the *Vortexes* must be so ranged, that the *Pole* of one *Vortex* may not touch that of another, but the *Ecliptick*, or those *parts* which are most remote from them; forasmuch as by this means they support and preserve one another.

XIII.
Those Parts
of a Vor-
tex which
are nearest
to the Cen-
ter, are
most swiftly
moved.

The *First Heaven*, in which the *Sun* S is the *Center*, and by the force of whose *motion* the other *Planets* are wheel'd about, is most swiftly turn'd round by it; for the *Sun* being with great celerity whirl'd about its own *Axis* A B, carries the nearest *parts* along with it, and imparts his *motion* unto them: So as that the *parts* nearest to him are more swiftly moved, than those that are more remote, and so on to the *Region* of *Saturn* H N Q R, where the *parts* of the *Heaven* are moved slowest of all. The Reason whereof is, because those *parts* that are nearer to the *Center* of the *Vortex*, are less than those further off, and consequently are more swiftly moved. And that the *parts* towards S, are less than those that are about H N Q R, is evident; for that if they were bigger or equal, by being so near the *Center* of the *Sun*, they must needs be more swiftly moved, and by consequence possess themselves of *Higher* places.

XIV.
Those parts
of the Vor-
tex which
are above
the Region
of Saturn,
are more
strongly
mou'd.

According to this Proportion therefore, the *motion* of the *Celestial Matter*, grows by degrees more flow to a certain term, beyond the *Region* of *Saturn* H N Q R, where the highest or utmost *parts* of this our *Vortex* begin to be more swiftly moved, not by the *Sun*, as is apparent enough; but from the *Neighbouring Vortexes*, which surround the *First Heaven*; for they being unequal, do variously shake the *Surface* of the *First Heaven*,

and thereby conduce to the swiftness of those *Parts*. This great degree of their swiftness, appears from the swift *motion* of the *Comets*.

From what hath been said, we may gather these two things: First, That the *Vortexes* are circularly moved; for being hindred by other *Bodies*, from proceeding in a *Right motion*, they are forc'd to change the same into a *Circular*, and therefore must continually be whir'd round.

Yet is it not necessary that these *Vortexes* therefore should be exactly *Round*; for tho' they counterballance one another by their equal Force, yet is not this Force equally dispers'd through all their *parts*; because those which are about the *Ecliptick* of one *Vortex*, are always more strong than those that are towards the *Poles* of another: Which makes (since the *Ecliptick* of one *Vortex* commonly meets with the *Poles* of others) the *parts* that are about that *Ecliptick*, to advance more towards the *Poles* of other *Vortexes*, than the *parts* which are about the *Poles* of other *Vortexes*, do advance towards this *Ecliptick*. We see also in the precedent *Figure*, that the *Neighbouring Vortexes* make the *Vortex* S, which is between them, irregular.

Secondly, We may gather from what hath been said, that the *Motions* of the *Vortexes* are *perpetual*, since there is nothing that can be assign'd that should change or diminish their *motions*. For a *Body* therefore only ceaseth to move, because by running against another *Body*, it imparts its *motion* unto it, which cannot happen to the *Heavens*, because they have no *Bodies* at Rest, or slowly Moved, to which they may communicate their *Motion*, and so come to lose it. For the *Law of Nature* requires, that every thing, inasmuch as it is single and undivided, should remain in the same state, nor ever be changed, but from *External Causes*; and since no such *Causes* are in the *Heavens*, but all the *Vortexes* do comply together, we are rather to conclude, that they maintain and preserve one another.

As to the Bigness of the *Vortexes*, we have no reason to think, that all those which were the result of the First Division of the *Matter*, were all of them *Equal*. For as the only Reason we have to believe, that the vast number of *Vortexes* are not confounded one with another, is, because their Forces are equal and opposite; we may also well imagin, that a *Vortex*, which is less than those that are about it, will for all that preserve its station amongst them, if we consider that the Defect of its Bulk may easily be made up by its greater degree of Swiftness in *motion*. This Inequality of the *Vortexes* is represented to the Eye in this *Figure*, where the *Vortex* S, tho' greater, cannot destroy that of O, nor K, tho' lesser than it.

We may gather from what hath been said, why *gross* and *Earthy Bodies*, are *Heavy* about the *Centers* of the *Vortexes*; tho' *Light*, when they are at a distance from them. For seeing these *Bodies* derive their *motion* from the *subtil Matter* wherein they swim; which *Matter* is actually turn'd Round, and inclin'd to move forwards in *strait Lines*; it by this means communicates its *Circular motion* to those thicker *Bodies*, which it carries along with it; but not the Force it has in proceeding in *right Lines*, save only so far as that Force accompanies the *motion* it imparts to them.

But

XV.
The Motions
of the Vor-
texes are
Circular.

XVI.
It is not
necessary
that the
Vortexes
should be
exactly
Round.

XVII.
The Hea-
vens are
moved
continually.

XVIII.
A small
Vortex may
preserve
it self,
amongst
others that
are great-
er.

XIX.
What Bo-
dies are
said to be
Heavy.

But because the *subtil Matter*, which is about the *Center* of the *Vortex*, hath much more agitation than is required to *Circular motion*, (for every of the *Particles*, besides the *Circular* or *Common motion*, are also variously moved) it so happens that those *Bodies* which have less *motion*, have also less *force* to continue their *motion* by *Right lines*, and by this their weaker *force*, are forc'd to give way to those, which with greater *force* press on towards *Strait lines*, and therefore must tend towards the *Center* of the *Vortex*, that is, become so much the more *heavy*, as they are more *solid*.

XX. What Bodies are said to be light.
But when *Earthly Bodies* are at a great distance from the *Center* of their *Vortex*, seeing the *Circular motion* of the *subtil Matter* is very intense, forasmuch as it employs almost all its *motion* in its *Revolution* about the *Center* of the *Vortex*, they have the more *agitation*, as they are more *solid*, because they follow the *motion* of the *subtil Matter* in which they swim; and therefore have more *force* to continue their *motion* according to a *Right line*: so that the *grosser Bodies*, at a certain distance from the *Center* of the *Vortex*, are by so much *lighter*, as they are more *solid*. For by the word *Lightness*, we understand nothing else, but the Endeavour wherewith the *Bodies* that are moved *Round*, tend to withdraw from the *Center* of their *motion*; as by the word *Heaviness* we understand that *strife*, whereby less agitated *Bodies*, or less *solid*, are thrust down towards the *Center* of their *motion*, by such as have more *force* than they to withdraw from it.

XXI. The Planets are not Heavy.
From hence it is evidently deducible, that the *Earth* about its *Center* is very *solid*, but less towards the *Circumference*; as also that the *Water* and *Air* must continue in that situation wherein we see them, and that consequently they are *Heavy*. For seeing all these *Bodies* are more *solid* than the *Matter* of the *First* or *Second Element*, they cannot avoid being push'd towards the *Center* by it: Whereas the *Moon*, being at a considerable distance from the *Center* of the *Vortex* of the *Earth*, is not look'd upon as *Heavy*, tho' it be a *solid Body*; as neither *Mercury*, *Venus*, *Jupiter*, and *Saturn*, which cannot fall down towards the *Sun*.

CHAP. XII.

Concerning the Action and Motion of the Heavenly Matter.

I. How Light was made in the First Day of the Creation.
HAvING thus been inform'd how the *Heavens* were ranged, and what Order they still keep, we are next to consider how the *Heavenly Matter* is moved, and what *Action* it exerts in them. For as soon as the *Vortexes* began to be formed, it could not be but that some part of the *Matter* of the *First Element*, made by the rubbing of the divided *particles* against one another, must be gather'd towards the *Center*, and from thence propel the surrounding *Globuli*, which was sufficient to make *Light*. And thus we may perceive how *Moses* is to be understood, when he saith, that *GOD* divided the *Light* from the *Darkness*, and that *Light* was in the *First Day* of the *Creation*: Because the *Matter* of the *First Element*, which was about the *Center* of each *Vortex*,

press'd the *Globuli* of the *Second Element*, and so procur'd the *Light*. Yea, this was in some measure effected upon the first Turn of the *Vortex*, before the *subtil Matter* run to the *Center*. For by the name of *Light* we can understand nothing else, than that pressure of the *Globuli* in *Right lines*, which does excite in us the sense thereof. And therefore, when it is said, that *GOD* commanded the *Light* to be, it must be thus understood, that *GOD* put the *parts* of *Matter* into *motion*, and gave them an *Inclination* to continue the same in a *strait Line*.

But after that the *Matter* of the *First Element*, by the continual rubbing together of the several *Bodies* was increased, it betook it self in great Quantity to the *Centers* of the *Vortexes* S L C K O, and there made the *Sun* and the *fix'd Stars* on the *Fourth Day*. For seeing that all *Circular moved Bodies*, continually strive to recede from the *Center* of their *motion*, and that those that are strongest recede farther than such as are weak; it follows, that the *Particles* of the *Second Element*, that are more strong than those of the *First*, because they are *solid*, do more recede from the *Center* of their *Motion*, and that in this their recess they push down thither all those *Particles* of the *First Element*, that are left after the filling the *Intervals*, which are between the *Particles* of the *Second Element*. Whence it follows, that about the *Center* of each *Vortex*, there is a *Body* only composed of the *Matter* of the *First Element*, which cannot but be of a *Round Figure* that way it turns; that is to say, If one should cut it by a *Flat* parallel to the *Ecliptick*, in what part soever this Section should be made, it would be always a *Circle*: For otherwise it must be supposed, that some *Particles* of the *Second Element* are not so far removed, as they might be, from the *Center* which they describe, which is impossible.

Now that *Body* of the *First Element* which is formed in the *Center* of a *Vortex*, is commonly called a *Star*; so that by this word *STAR*, we understand nothing else, but a *Body* compos'd only of the *First Element*, which has been driven by that of the *Second*, towards the *Center* of each *Vortex*.

It is evident from what hath been said, that the *Matter* of the *First Element*, is not every where moved alike, but more strongly in the *Bodies* of the *Lucid Stars*, than without them in the *Globuli* of the *Second Element*. For the *subtil Matter* gather'd together in the *Sun* or *fix'd Stars*, hath a greater *force*, by reason of the Consent of its *Parts* to all those swift *motions*, by which it pusheth forwards the *Ethereal Matter*, or the *Heavenly Globuli*. But without the *Stars*, and between the *Globuli*, its *force* is diminish'd, and by being divided, is much weaker: So that every one of its *Particles* are push'd this way and that way, by the *Globuli*, and thereby are forc'd to comply with their various *motions*. Hence it is, that the *Matter* of the *First Element*, because of the exceeding finalness of its *Parts*, is forc'd to change its *Figure*, and to be toss'd with various *motions*. For as it is tost amongst the *Globuli*, it hath several *motions*; first, its own proper *Motion*, by which it continually changeth the *figure* of its little *particles*, to be fit to fill up exactly all the *Corners*

II. How the Sun and fix'd Stars were made the Fourth Day.

Figure 20.

III. What we understand by the word Star.

IV. The most subtil Matter is most strongly mov'd within the Bodies of the Stars.

it passeth through. Next it hath a *Circular motion*, which is common to all *motions* that are moved together. And lastly it hath a *Straight motion*, whilst by the *Circular motion* of the *Vortex*, it is thrust in great abundance towards the Parts that are most remote from the *Poles*.

V.
A motion
may be va-
rious, and
yet conti-
nues one and
the same.

And tho' there can be but one *Proper motion* assign'd to a thing, yet doth not this thwart the Truth of what we have just now said, because tho' this *motion* hath several names, yet it is still but one and the same, from the *Center* to the *Circumference*, by a *right Line*, tho' in its going forth it may undergo several *Figures*; even as the *motion* whereby any *Liquor* is transmitted through a *Channel* or *Pipe* is said to be one, tho' it run to the term to which it is directed, in one place through a *square Pipe*, in another through a *Triangular*, in one through a narrower, in another through a wider *Pipe*.

VI
The great
Globuli are
more strong-
ly moved
than the
less.

We are also to take notice of some difference there is between the *Globuli* of the second *Element*, because the Bigger, as being more *Solid*, are more suited to receive a swift *motion* from the matter of the first *Element*, than the Less, and therefore they are more swiftly moved, and withdraw further from their *Center*.

VII.
The matter
of the first
Element
continually
passeth
from one
Vortex to
another.

Next, we are to consider that the first *Element*, is continually carried towards the *Center* of each *Vortex*, from other Neighbouring *Vortexes* about it, by those Parts which are nearest to the *Poles*, where there is least resistance, that so they may make up again that which is lost: But that the same matter breaks out of its own *Vortex* into others, by the *Ecliptick* or those parts which are furthest from the *Poles*. For let us suppose *A B*, to be the *Poles*, about which the *Vortex* in which we are, *Whirls round*, *H* and *Q* to be the *Ecliptick*, or Parts most remote from the *Poles*, where the *motion* is the *Swiftest*. Let us also suppose the *Vortex* to be *A Y B M*, round about which four others *Vortexes L C K O* rowle, so as to touch *O* and *C*, at their *Poles*, and the other two *K* and *L*, in those Parts that are most remote from their *Poles*; I say, this supposed we may easily guess, that the matter which strives to withdraw from the *Axis A B*, of our *Vortex*, doth with greater Force tend towards the Parts *Y* and *M*, than towards *A* and *B*. The reason is, because the most subtil matter in *Y* and *M*, meets with the the *Poles* of the *Vortexes O* and *C*, where there is no great Force of Resistance; whereas in *A* and *B*, it meets with those parts of the *Vortexes K* and *L*, which are most remote from their *Poles*, and have a greater Force of moving from *L* and *K*, towards *S*, than the Parts about the *Poles* of the *Vortex S*, have to tend towards *L* and *K*; and therefore it is manifest, that the most subtil matter which is in *K* and *L*, must move on towards the *Center* of our *Vortex S*, and that that which is in *S*, must tend towards the opposit *Vortexes C* and *O*. So that as much of this subtil matter, as gets out through *Y* and *M*, so much of the same matter enters, from the other *Vortexes L* and *K* through the *Poles* of our *Vortex*.

VIII.
But not the
Matter of
the second
Element.

But there is no such passage of the matter of the second *Element* from one *Vortex* to another; for being whirled round as well as the subtil matter, it endeavours to preserve its Swiftness, but would certainly lose much of the same, if it should wan-

der out of the limits of its own *Vortex*, since the *motion* is so very flow in the *Polar Parts* of the other *Vortexes M* and *Y*, that it cannot meet with any free entrance there. Yea, tho' we should suppose, that the *Aethereal Globuli* should pass from the *Poles* of one *Vortex*, towards the *Center* of another; and that all the matter both of the first and second *Element*, contained in the *Vortex L*, at the very same moment of time, had begun to move, from the middle place between the *Centers S* and *L*, towards *S*; yet we shall easily understand, that the said subtil matter will arrive sooner at the *Center S*, than the *Globuli* of the second *Element*. Because the Agitation of the first *Element* far surpasseth that of the second, and hath always an open passage, through those little *Angles*, which cannot be fill'd up by the matter of the second *Element*. To which we may add, that the matter of the first *Element*, by passing through the narrow spaces left by the *Globuli*, meets with no impediment, nor loseth any part of its Swiftness, seeing that according to the Laws of *motion*, it always endeavours to recede from the *Center*, and hath a force to persevere in its Swiftness.

Having thus seen how the Matter of the first *Element*, which is impatient of Rest, breaks forth from one *Vortex* to another; we are to enquire how the said matter is moved amongst the *Stars*. Consider we therefore, that a part of the most subtil matter, in the Space *d e f g*, where we place the *Sun*, moves from *A*, by a *right line* to *d*, and there meeting with the *Globuli* of the second *Element*, beats them back towards *B*; and that contrarily another part of the said matter comes from *B* to *f*, and there drives before it the *Globuli* of the second *Element* which it meets with, towards *A*, and that immediately thereupon, as well the matter about *d*, as about *f* becomes reflected towards all the parts of the *Ecliptick e g*, and doth equally drive before it all the adjoining *Globuli* of the second *Element*, and lastly gets away into *MY*, through the materials that separate those *Globuli*, about the *Ecliptick e g*.

VVhereupon this Space must needs be *Spherical*, because the matter of the first *Element*, which is entred into the *Body of the Sun* by its *Poles A B*, must equally beat back all the circumjacent *Globuli* of the second *Element*, as well those, against which it is only obliquely reflected, as the other against which it pusheth in a direct *Line*; after the same manner as we see, that a *Glass pipe* is formed *Round*, because the *Air* driven through the *Iron pipe*, with an equal force spreads it self round, and equally presseth it on all sides.

The matter of the first *Element* without the *Stars*, or whilst it wanders between the *Globuli* of the second *Element*, hath a various *motion*. For first it hath a *Proper motion*, whereby it runs to the filling up of the little Spaces left by the *Globuli* of the second *Element*, which the diversity of *motion* changeth every moment. And it hath also a *Circular motion* about the *Poles*, common to the whole *Heaven A M B Y*; because that which is contained between the little spaces of the *Globuli*, follows the *motion* of them. As *Water* contained in a *Barrel*, follows the *motion* of it, and accommodates its self to its *Figure*. It hath also a *Straight motion*, from the *Poles A B* to the *Sun*; and like wise from the *Sun* to the *Ecliptick Y M*, according-

IX.
How the
matter of
the first
Element is
moved a-
mongst the
Stars.

X.
The motion
of the mat-
ter of the
first Ele-
ment is the
cause of
the Round-
ness of the
Stars.

XI.
The motion
of the sub-
til matter
amongst
the Globu-
li is vari-
ous.

ing to the Law of motion, that things which are circularly moved, always tend to recede in a right Line, from the Center of the Circle they describe.

XII.
The matter of the first Element hath a greater force in the Stars than without them.

VVhence it appears that the matter of the first Element, collected in the Center of the Sun and first Stars hath a very great Force, because the motion of all its particles do readily agree and conspire together, to push forward the Globuli with an equal Force: But this Force grows weaker out of the Body of the Stars, because it spends the greatest part of its Agitation, in changing the Figures of its little Particles, to the end it may exactly fill all the little Corners through which it passeth.

XIII.
Of the Figure of the Strait or Screw-like Particles.

VVherefore whilst the matter of the first Element, passeth through the Triangular intervals 1 and 2 of the Globuli touching one another, it must needs assume a Triangular Figure, and become shaped into striate Particles 3 and 4 bent a contrary way. It is not easy to determin the length of those Particles, because this depends on the slenderness or abundance of the matter, whereof they are made: But it is sufficient to conceive them like little Columns, with three Notches round them like a Screw; so that in their whirling round, they may pass through those narrow passages 1 and 2 of a Triangular Form. For seeing that they are longish, and with a most swift motion pass between the Globuli of the second Element, which touch one another, whilst the Globuli in the mean time by a different motion are whirled round, about the Poles of the Heavens, we clearly understand, that their Notches must go winding about, like those of Screws, which winding must be more or less according as they pass through parts that are more remote from the Axis of the Vortex, or nearer to it, because they move more swiftly in those, than in these.

Figure 21.

XIV.
The Globuli of the second Element, have not the same bigness every where.

As to the Globuli of the second Element, of which the Vortexes consist, they are not all of the same bigness; for those that are nearer to the Star and its Center, are less than those that are farther off, and consequently absolve their Circle in a less time. VVhich inequality of their Magnitude, extends it self to the Region of Saturn H N Q R, where the parts of Heaven move most slowly. Yet beyond that Orb it is probable, that the Globuli are all of an equal Magnitude, and that the Higher move more swiftly than the Lower. So as that the Higher must move more swiftly towards M and Y, than the Lower towards H and Q. The reason whereof is amongst other things, that the bordering Vortexes being unequal, the motion of the subtil matter, between those unevennesses of the surface, becomes much accelerated.

I.
What the Sphere is.

CHAP. XIII. Of the Heavenly Sphere and its Circles.

BY the word Sphere we understand that common instrument of a round Figure, consisting of several Circles, invented to explain and represent the Heavenly motions, and the Fabrick of the whole VVorld. This Sphere hath a little Ball in the midst or Center of it, with an Axis through it, the Extremities whereof are called Poles, about which the whole Body of the Heavens is supposed to turn round in the Space of 24 hours.

The Axis of the World is a right Line, which extending from one Pole to the other, passeth through the Center of the World. By this the Earth is said to be supported: Not that there is indeed any such visible Axis in the Globe of the Earth, which is terminated in the Heavens, and whereby the Earth is sustained; but only that such a Line is understood, which passing through the Center of the Heaven and Earth, reacheth to the utmost Heaven, and ends at two points, which are called the Poles of the World.

II.
What an Axis is.

The Poles therefore are nothing else but the Extremities of the Axis, or two Points in the highest Heaven, Diametrically opposit, about which the whole bulk of the Heavens is conceived to be whirled about. The one of these Poles is always visible to us, and from its nearness to the constellation of the Bear is called Arctick, the other which is always hid from us, being from its opposition to the former called Antartick.

III.
What the Poles are.

The Northern Pole is reard in sight on High,
The other hid under our Feet doth lie.

There are ten Circles in an Artificial Spheres six whereof are called Greater, whose Diameter passeth through the Center of the World, or which divide the Sphere into two equal Parts, and these are the Horizon and Meridian (between which standing immoveable, the other Circles are turned round) the Equator, the Colure of the Solstices, the Colure of the Equinoxes, the Zodiack or broad Circle, and the middle line thereof, which is called the Ecliptick. The four lesser Circles are those whose Diameter doth not pass through the Center of the World, or which divide the Sphere into two unequal Parts. They are the Tropic of Cancer, the Tropic of Capricorn, the Arctick and Antartick Circle, which also with the Equator are called Parallels, as being at an equal distance from each other.

IV.
The Circles of the Spheres are called Greater or lesser.

The Equator or Equinoctial Circle, which is the chiefest of all the rest, is that Circle, which in all its parts is equally distant from the Poles of the World, which it divides into the Northern and Southern Hemisphere. By the Greeks it is called the Even-day Circle, because the Sun twice in a year, that is about the 10 of March, and the 13 of September intersecting the same, makes two Equinoxes, by rendering the Days and Nights equal, through his equal stay above and under the Horizon, because the Equator intersected by the Horizon, becomes divided into two equal parts, one Superior, and the other Inferior.

V.
The Equinoctial Circle.

The Zodiack is a greater Circle superinduced over the other moveable Circles, unequally distant from the Poles, and intersecting the Equinoctial at two opposit Points; so that its middle line which is called the Ecliptick, hath one part of it inclining to the North Twenty three degrees, and Twenty eight minutes, according to the Antients, and the other part of it as many degrees reaching towards the South. This Circle is conceived Broad, because the Planets which move through it, do not all of them keep the same tract, but whilst the Sun takes it Course through the midst of this they Circle, along the Ecliptick they swerve to the North and South. The Points at which the Zodiack intersects the Equator, are called the Equinoctial Points: because when the Sun

VI.
The Zodiack.

Sun reacheth them, it makes *Day* and *Night* of equal length. And the *Points* by which the *Ecliptick*, declines furthest from the *Aequinoctial*, are called the *Solstitial Points*, because when the *Sun* comes to them he seems to stand still. The *Zodiack* is furnished with twelve *Signs* or *Constellations* of which hereafter.

VII.
The Colures
of the Sol-
stices and
Equinoxes.

The *Colures* are two greater *Circles*, which intersecting one another in right *Angles* at the *Poles*, do intersect all the other moveable *Circles*, dividing them into four equal *Parts*. For the *Colure* of the *Solstices* passeth through the *Poles* and the *Solstitial Points* of *Cancer* and *Capricorn*; but the *Colure* of the *Equinoxes* is described through the *Poles* of the *World*, and the *Aequinoctial Points* of the *Zodiack*, at *Aries* and *Libra*. The use of the *Colure* is to mark out the four *Cardinal Points*, viz. the beginning of *Aries*, where whilst the *Sun* is, the *Night* is equal with the *Day*, and the *Spring* begins; the beginning of *Cancer*, where the *Sun* makes the longest *Day*, and begins *Summer*; the beginning of *Libra*, where the *Sun* makes *Day* and *Night* equal, and begins *Autumn*; and the beginning of *Capricorn*, where the *Sun* makes the shortest *day*, and *Winter* begins.

By *Crab* and *Capricorn Solstice* is made,

The *Ram* and *Ballance* equal *Light* with *Shade*.

VIII.
The Horizon.

The *Horizon* is the utmost *Circle* in a *Sphere*, encompassing all the rest, and is that *Circle* which is equidistant from the *Vertical Point* of every place; and therefore is called by the Greek *Horizon*, that is to say, *Terminator* or *Finisher*, because it boundeth our light. For when standing in a *Plain* we take a *Prospect* round about, we see the *Heavens* every where, as it were touching the *Earth*; from which *Commisfure* of the *Heaven* and *Earth* as the *Stars* get upwards, they are said to *Rise*, and when they sink beneath it are said to go down. Tho' the *Horizon* with regard to every particular place of the *Earth* be *immoveable*, yet considered in general it is mutable, forasmuch as whilst we *Travel* from one place to another, we also pass from one *Horizon* to another.

IX.
The Meri-
dian.

The *Meridian* is a greater *Circle* which passeth through the *Poles*, and the two *Points*, the one directly over our heads, called the *Vertical Point*, and the other opposit to it, under our Feet called the *Nadir*. This *immoveable Circle*, within which the other *Circles* are moved, is called the *Meridian*, because when ever the *Sun* reacheth it, he makes *Noon* or *Midday*, by dividing the *Day* into two equal *Parts*. Whence it appears, that the *Altitude* or *Elevation* of the *Pole* in every *Country*, is nothing else but that *Arc* of the *Meridian*, which is intercepted betwixt the *Horizon* and the elevated *Pole*, and whose complement to the *Zenith* or *Quadrant* of the *Circle*, is always equal to the *Altitude* of the *Aequator*.

X.
The Tropicks
of
Cancer and
Capricorn.

The *Tropick* of *Cancer* is a less *Circle*, Parallel to the *Aequator*, passing through the *Northern Solstitial Point* of the *Zodiack*. The *Tropick* of *Capricorn*, is a less *Circle*, Parallel to the *Aequator*, passing through the *Southern Solstitial Point* of the *Zodiack*. They are called *Tropicks*, that is to say *Turn-agains*, for that as soon as the *Sun* in his withdrawing from the *Aequator* reacheth them, he begins to return again towards it. Their distance from the *Aequator* is 23 Degrees and an half; that

being the furthest *Elongation* the *Sun* ever makes from that *Line*; wherefore, also it is called the greatest *Declination* of the *Sun*.

The *Artick* or *Northern Polar Circle*, is a less *Circle*, Parallel to the *Aequator*, passing through the *Pole* of the *Zodiack*, near the *Northern Pole*. The *Antarctick* or *Southern* is a *Circle* passing through the other *Pole* of the *Zodiack*, near to the *Southern Pole*. These two *Circles* are at the same distance from the *Poles*, as the *Tropicks* from the *Aequator*, that is 23 Degrees and an half. They have also this common use with the *Tropicks*, that they serve to distinguish the *Zones*, the *Torrid* being comprehended within the *Tropicks*; and the *Frigid* within the *Polar Circles*; but the *Temperate Zones* lie between the *Polar Circles* and the *Tropicks*.

All these *Circles*, the *Aequator*, *Ecliptick*, *Meridian*, with the *Tropicks* and *Polar Circles*, are applied to the *Terrestrial Globe*: For the *Earth* also hath its *Aequator*, commonly called the *Line*, corresponding to the *Caelestial Aequator*; and every place on the *Earth* hath its own *Meridian*. And these *Circles* are exceeding useful to distinguish the various *Situation* of *Places*, as well as to the *Art* of *Navigation*, and to the *Knowledge* of *Geography*. For since we may distinguish the *Earth* as well as the *Heaven*, in *Length* and *Breadth*; the *Latitude* of any *Place* is nothing else, but a *Portion* of the *Meridian*, intercepted between the *Aequator* and that *Place*. Wherefore, those who live under the *Aequinoctial* have no *Latitude*; whereas they have the greatest *Latitude*, who are at the greatest distance from the *Aequator* under the *Poles*. The *Latitude* of a *Place*, is the same with the *Elevation* of the *Pole*, for they who live under the *Line*, see both the *Poles* in their *Horizon*, but as we withdraw from the *Aequator*, one of the *Poles* is *Elevated* above our *Horizon*, and the other depressed beneath it.

But the *Longitude* of a *Place* is taken in the *Aequator*, and is nothing else but a *Part* of the *Aequinoctial Circle* intercepted between the *Meridian* of any particular place (suppose *Paris*) and the first *Meridian* appointed by the consent of Men, which *Meridian* is conceived to pass through the *Islands*, of *Azores*.

A *Sphere* is either *Right* or *Oblique*. A *Right Sphere* is that whose *Horizon* passing through the *Poles* of the *World*, cuts the *Aequinoctial* at *Right* or *Equal Angles*.

An *Oblique Sphere*, is that whose *Horizon* cuts the *Aequator* at unequal *Angles*, and doth not pass through the *Poles* of the *World*.

They therefore have a *Right Sphere*, who live under the *Aequator*, and they an *Oblique* who live under the *Tropicks*. Whence it appears that the *Sun* and the rest of the *Stars* in a *Right Sphere* *A B C D*, to them that live under the *Aequator* *B*, seem to rise and set in *Right Lines*, both the *Poles* lying on the *Horizon*; whereas in an *Oblique Sphere* *E F G H*, (where one of the *Poles* *E*, and the *Axis* of the *World*, is more or less obliquely inclin'd towards either side of the *Horizon*) they are seen to rise above the *Horizon*, come to the *Meridian*, and set beneath the *Horizon* obliquely. For any one may easily apprehend, that where both the *Poles* lie on the *Horizon*, there the *Aequator* must be *Vertical*; and seeing it cuts the *Horizon*

XI.
The Ar-
tick and
Antarctick
Circles.

XII.
Whence the
Latitude
of a Place
is taken.

XIII.
Whence the
Longitude
is taken.

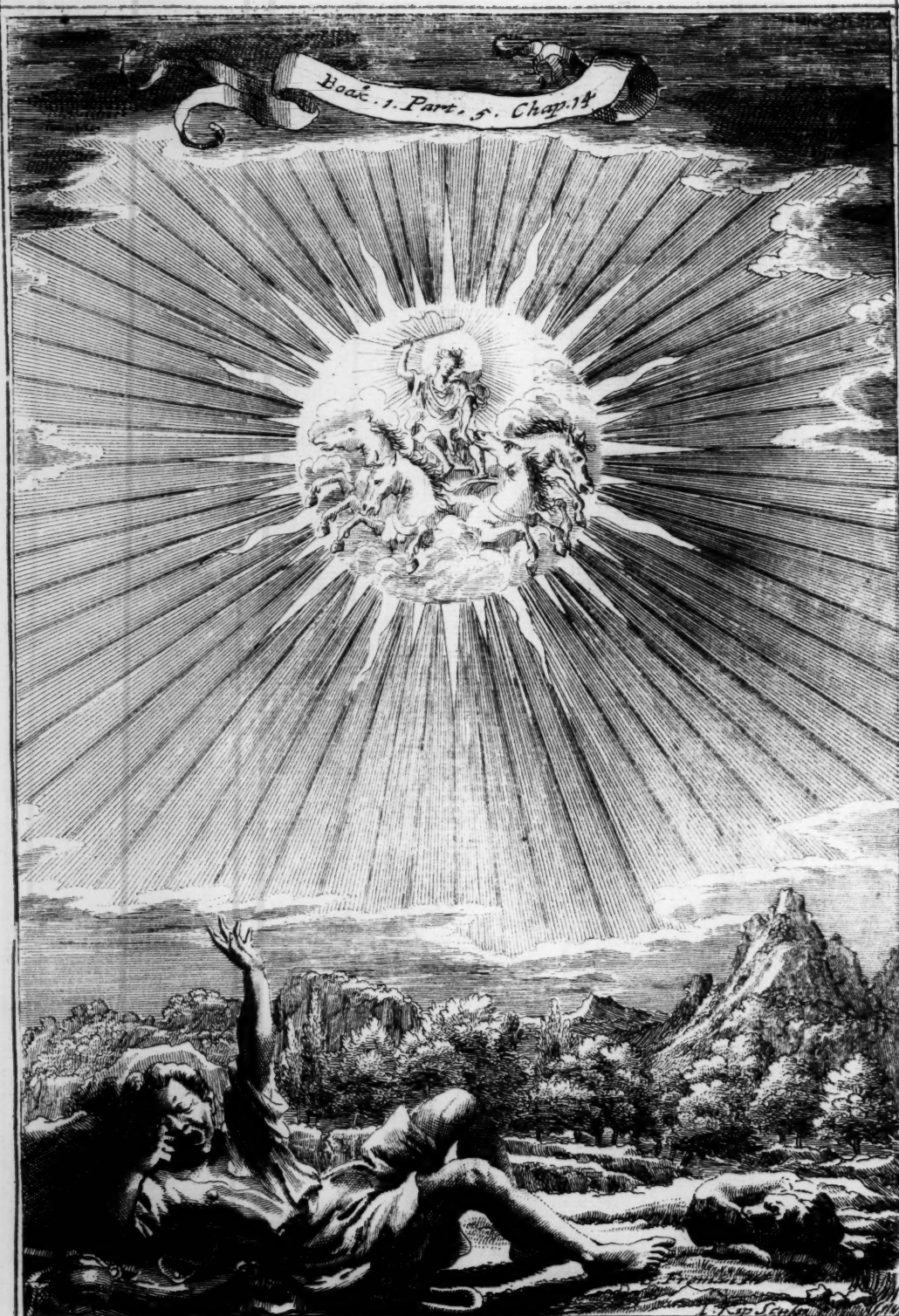
XIV.
What a
Right
Sphere is.

XV.
What an
Oblique
Sphere is.

Figure
22.

Figure
23.

zon



To the Right Honourable
Ribston Park in York -
Leivtenant Generall of
nance, and one of
most Honourable



S^r Henry Goodrick of
Shire K^t and Baronet,
their Majesties Orde=
the Lords, of their
Privy Councell &c^t

This Plate is humbly Dedicated by Richard Blome.

zon at *Right Angles*, the *Stars* must needs arise and set in *Right Lines*; and in like manner, whatsoever else is in the *Heaven*, forasmuch as all the *Circles*, which they describe *parallel* to the *Aequator*, will likewise cut the *Aequator* at *Right Angles*. And on the contrary, those that live between the *Aequator* and the *Elevated Pole*, because of the *Oblique ascent and descent*, have some *Stars* always in sight, and others ever out of sight.

CHAP. XIV.

Of the SUN.

From what hath been already said of the *Formation* of the *Heavenly Matter*, we may easily understand how the *Sun* was formed at first. For whilst the *Globuli* of the *Second Element*, being more *solid* than the *Matter* of the *First*, withdrew from the *Center*, betaking themselves to the *Circumference*, the most *subtil Matter* being increased to too great a quantity (from the continual rubbing of *Bodies* against one another) to be contained in their *Intervals*, rush towards the *middle part*, where being tost with different *motions*, and most swiftly whirl'd about its *Center*, it constituted the *Sun*, and the other *fix'd Stars*. For seeing that our *World*, in the midst whereof the *Sun's Seat* is, and which extends it self beyond the *Sphere* of *Saturn*, doth constitute one great *Vortex*, whose fluid and transparent *Matter* is circularly moved; it must follow that the *Globuli* of the *Second Element* will strive to recede from their common *Center*, and as far as their *Figure* and *Motion* will permit, come nearer together, and lye upon one another; which they cannot do, without driving the *Matter* of the *First Element*, whereof there is greater store than is needful, to fill their *Intervals*, towards that place which they have left; so that it cannot be, but that about the *Middle* of the *Vortex*, there must be a great *concourse* of the *Matter* of the *First Element*; which we take to constitute the *Body* of the *Sun*.

Accordingly we may define the *Sun* to be a *Lucid Body*, consisting of the *Matter* of the *First Element*, gather'd together in the *Center* of a *Vortex*, in the room of the *Globuli* that recede from it.

From the Account we have here given of the *Sun's Formation*, we gather first, that the *Sun* must be of a *Round Figure*; because the most *subtil Matter* entering the *Sun* at either of its *Poles*, continues its course in a *Right line*, until it meet with the *Globuli* of the *Second Element*, which are about the opposite *Pole*, and running against them, drives them forward by the force of its *motion*, and thereupon is immediately reflected, and turns round in all its parts towards the *Ecliptick*, and so drives forwards the adjacent parts of the *Second Element*, that are next to the *Center* of the *Star*, and by this means makes the *Sun* to be *Round*: So that if it should be intersected by a *Plain*, parallel to the *Ecliptick*, in whatsoever part the Section be made it will always be a *Circle*. For otherwise it would follow, that some parts of the *Second Element*, do not recede so far as they can from the *Center* of the *Circle* they describe; but this is impossible, considering the *Fluidity* of the *Heavens*.

In the *Second place*, we infer from hence that the *Sun* is *Lucid*; because the *Matter* of the *First Element*, gather'd together in the *Center* of the *Vortex*, by pressing every way upon the *Heavenly Globuli*, (besides the *motion* they have, as they are a *Liquid Body*) do communicate to them such a force or impression as is sufficient to affect our *Eyes*, as to produce the *sense* of *Seeing*.

The *Sun* therefore, and the rest of the *fix'd Stars*, shine with their own *Light*, which their brisk and lively *Rays* are an evident Proof of. And the reason why the *Sun* appears so great to us, in comparison of the *fix'd Stars*, is, because he is nearer to us, who are in the same *Vortex*. For which reason also, the *Sun* doth not only abundantly illuminate our *Earth*, whence he is called in *Scripture*, the *Greater Light*; but also communicates heat and warmth to the same: Whereas the *fix'd Stars*, tho' visible to us; because of their *Remoteness* can do neither.

The *Sun* therefore is no *solid Body*, neither a burning *Stone*, nor *Red-hot Plate*, as some of the *Ancients* apprehended, but consisting of a very fluid and movable *Matter*, which whirls all the *Circumjacent parts* of *Heaven* round with it. And thus much is not only confirm'd to us by *Reason*, but also by *Astronomical Observations*: For *SIMON MARIUS*, in *Scheinerus* his *Rosa Ursina*, tells us, That he had beheld the *Sun* thro' an *Optick Glass*, boiling like molten *Gold* in a *Furnace*. *ATHANASIUS KIRCHERUS*, in his *Book* entituled, *Ars magna Lucis & Umbræ*, writes, That he had seen the *Sun*, like to the *Sea*, tost and foaming with *Waves*. And *RAPHAEL AVERSA* assures us, That he had observ'd the *Sun* to be a *Fluid Body*, contain'd in its place, as if it were in a *Vessel*, and agitated within it self, like a molten *Metal*. Yea, there are several who have assured me, that the whole *Body* of the *Sun* boils continually, and that they had often observ'd it through a *Prospective-Glass*, boiling like *Water* in a *Kettle*.

Whence all *Modern Philosophers* that are of any Note, take it for granted, that the *Sun* is nothing else but a *Fire* or *Flame*. Since we have great reason to conclude that *Body*, which gives forth *Warmth* and *Light*, to be *Fire*; but we Experience the *Sun* to give forth *Heat* and *Light*: Therefore we must conclude the *Sun* to be a *Fire*. The *Minor* is manifest, because we are convinced that both these proceed from the *Sun* by our *Feeling* and *Sight*; neither do we find any thing in the *Fire*, which we may not with equal right attribute to the *Sun*. Besides, we cannot conceive any *Body* to have an *inborn* or *connatural Light*, by means of which it produceth *Heat*, except it be of the nature of *Fire*. Wherefore, seeing the *Sun* is as communicative of *Light* and *Warmth*, as *Fire* is, and that both of them have the same Properties; for the *Sun* dries, melts, kindles, and burns, as well as *Fire*: Therefore we must conclude that the *Sun* is *Fire*. For we can have no stronger Argument to prove two things to be the same, than by demonstrating, that all the *Effects* of one of them, do also proceed from the other. For as if any one by *Night* should meet with a *Body* that sent forth flames, heated the *Bodies* that were near it, and enligned the *Air*, he would make no scruple to conclude it to be a *Fiery Body*: In like manner,

IV.
Why the
Sun is
Lucid.

V.
How it
comes to
pass, that
the Sun
appears so
much
greater to
us than
any of the
fix'd Stars.

VI.
The Sun
is a Fluid
Body.

VII.
The Sun is
a true
Fire.

I.
How the
Sun was
formed at
first.

II.
What the
Sun is.

III.
Why the
Sun is
Round.

seeing the Sun performs all these things, we are not to question but that it is a Fire or Flame.

VIII.
Why the
Sun's heat
is greater
in Summer
than in
Winter.

But against this you will object, First, if the Sun were a Flame, and as such continually diffus'd its heat through the whole World; it would follow from hence, that the Air would never be cold; but this is contrary to Experience: For we find the Air much hotter in Summer, than in Winter.

Some endeavour to solve this Objection, by saying, that the Difference of Heat we feel at divers Seasons, proceeds from the various incidence of the Sun-beams on the Surface of the Earth, which in Summer come down to the Earth more directly, and in Winter more obliquely or slantingly. But this Answer will scarcely satisfy those, who consider that the Surface of the Earth is not polish'd, as a Looking-Glass, but rough and very uneven; and that consequently it may receive direct Rays in Winter, as well as Summer. The reason therefore why the Cold is more intense about the Earth in the Winter-season, is, because the Air we breath in, which is ten or twelve Miles high, hath a very smooth and even Surface, as having no Winds to ruffle it; and the Sun-Rays falling very slantingly in the Winter upon this smooth Surface, is the reason why fewer Rays are transmitted to us in Winter, than in other Seasons of the Year. To which may be added, that more Vapours and Exhalations at that time proceed from the Earth and Sea, which filling the Air, do allay the Heat of the Sun.

IX.
The Sun is
fed and
maintain'd
as our
Fires are.

In the Second place, you'll object, That our Fire here below stands in need of Fuel, which is no sooner taken away, but it becomes extinct, and vanisheth: But in the Heaven there is no Fuel to feed the Sun's Flame: Therefore it is a great mistake to suppose it a Fire.

X.
The Sun's
Flame is
not weak-
ned by the
Bodies
that are
about it.

I Answer in the first place, That the state of the Sun, and our Flames here below, is very different: For our Flames stand in need of Nourishment, because they are compos'd of a Fluid and Moveable Matter, which is easily destroy'd by the Bodies that surround it; and therefore it is needful it should be furnish'd with New Matter, to supply that which is extinguish'd and vanisheth. But above the Sun there are no such Agents as are able to dissipate its Matter, and therefore it needs no Fuel to preserve it. For so vast a quantity of Fiery Matter is heap'd up in the Sun, that it can neither be exhausted or extinguish'd by it self, nor by the Heaven that surrounds it.

XI.
The Sun is
fed and
maintain'd
by the
Matter of
the First
Element.

I answer in the Second place, That the Matter of the First Element is the Fuel of the Sun's Flame, which is continually convey'd to the Sun, in the room of the like Matter, it loseth at any time. For the Stars entertain such a Communication among themselves, as to convey food to one another through their Vortexes, bestowing upon others what goes out by their Ecliptick, and receiving from others what comes in by their Poles. And thus New Matter continually enters into the Sun, by the Poles, and other Matter again flows out from it, in that part which is farthest from the Poles. And accordingly the Sun is always said to be the same, in like manner as a River is supposed the same, notwithstanding that New Matter con-

tinually makes up the defect of that which runs away.

The Sun is not only the Cause of the Light, which in the day time is diffus'd through the Air; but also of the Twilight, which is perceived in the East before its Rising, and in the West after its Setting; forasmuch as the Rays of the Sun falling obliquely upon the Vapours that are in the Air, are refracted towards the Earth. The Beginning of this Twilight happens, when the Sun is deprest beneath our Horizon, about 18 Degrees, perpendicularly taken from the Vertical Circle. Hence it is, that in those parts of the Earth where the Sun doth not in Summer sink below the Horizon 18 Degrees, there they have a continual Twilight all Night long.

XII.
How the
Sun makes
Twilight.

Whatsoever part of the Earth the Sun salutes with his Rays, there he is said to Rise; and to Set in those Parts which he ceaseth to illuminate. Now forasmuch as there is no part of the Earth in which he may not sometimes Rise, and sometimes Set in this manner, we may assert, contrary to the Vulgar receiv'd Opinion, that there are no certain Points of the Sun's Rising or Setting.

XIII.
There are
no certain
Points of
the Sun's
Rising and
Setting.

CHAP. XV.

Of Light.

The Peripateticks generally are of Opinion, that Light is a Quality really distinct from Substance; and propagated to the Senses they don't know how. But this Opinion, at present, hath but few Followers:

I.
The Opinion
of the Pe-
ripateticks,
concerning
Light,
retuted.

First, Because it is evident, that Qualities are no Entities really distinct from Substances, but only their Modifications, which neither can remove from the Substances wherein they are, nor do any thing without them.

Secondly, Because the Beams of Light are reflected from some Bodies: Now every Reflexion is caus'd by Resistance, and whatsoever meets with Resistance, must be Corporeal; but forasmuch as meer Qualities, abstracted from Substances, include nothing of Corporeity, neither can they be liable to Resistance. Whence we must conclude, that Light which is Reflected, is no pure Quality, separately existing from the Lucid Body.

Thirdly, The Rays of Light are refracted, and by the help of Convex-Glasses are strengthened; which could not be in case the Light were a meer Quality, for then, as being destitute of all Quantity, it would equally penetrate all Bodies. For the better understanding whereof, two things especially are to be supposed.

First, That all Bodies consider'd in themselves, strive to move in Right lines. For a Stone thrown from you always moves strait forwards towards some part or other; nor ever turns aside, except by other Bodies meeting with it, it be forced to rebound or deflect. Secondly, That whatsoever is Circularly moved, as far as it is able, strives to recede from the Center of its motion; as we may experience in a Leaden Bullet tied to a String, for we feel that the swifter the Bullet is whirld about, the stiffer the String is extended and stretch'd; which cannot be attributed to any other Force, but because it strives to recede from the Center of its motion.

II.
Two things
are to be
supposed,
in order to
the under-
standing of
the Nature
of Light.

When

III.
What is
to be un-
derstood
by the
word Scri-
ving.

When I say, that the *Bullet* strives to with-
draw from the *Center* of its *motion*, it is not so to
be understood, as if the *Bullet* or any other *Body*
had a perceptive inclination to move one way
rather than another; but only that it hath such an
impulse to *motion*, that it would move in such a
manner, in case it were not hindered of something
else.

IV.
How Light
is produ-
ced.

We assert therefore, that *Light* consists only in
this, that the *Matter*, which is in the *Center* of
every *Vortex*, by its swift *whirling* about, doth
shake the *Luminous Matter*, that is dispers'd
throughout the whole *Heaven*, and all *Diapha-
nous Bodies*, which in *Right lines* beating against
the *Nervous Fibres* of the *Tunica Retina*, pro-
duceth that perception, whence *Bodies* are deno-
minated *Lucid*: For as a *Blind man* by the means
of his *Staff*, because of its *Resistance* only, is able
to distinguish betwixt *Bodies*; tho' no *Species* be
transmitted by the *Stick* to the *Eye*: So likewise
the Cause of the Perception of *Light* is nothing
else, but that a certain *Matter* dashing against
the *Organs of Sight*, stirs up the *Soul* to such an *Animadversion*.

V.
What
Light, and
the Rays
of Light
are.

Light therefore is a *Quality* proceeding from the
Vibration of the *Globuli* diffus'd in *Right lines*,
and moving the small fibres of the *Optick Nerve*,
disperst through the *Net-like Membran* of the *Eye*.
Which is then chiefly, when the *Matter* of the
First Element, contained in the *Center* of the
Sun, or any other *Lucid Body*, strives to with-
draw from it: For in so doing it presseth the adja-
cent *Globuli* of the *Second Element*, and they again
those which are above them to the very last. So
as that by this means the *Light* is diffus'd in a
moment, to any distance whatsoever. Which will
not be hard for us to conceive, if we consider that
the *Action* of *Light* doth not so much consist in
Motion, as in *Pression*, or a first disposition to *Mo-
tion*; and therefore that the *Rays* of *Light* are
nothing else but so many *Lines*, by which that
quick and lively Action is performed.

VI.
The Sun
equally
diffuseth
its Light.

From whence we conclude, that the *Sun* doth
not more forceably drive forwards the *Matter*
which is towards the *Ecliptick*, than that which is
towards its *Poles*: For the *Sun* being of a *Round
figure*, the *Matter* of the *First Element* entring
into its *Center*, doth equally drive from it all the
Globuli that surround it; so that no greater Force
proceeds from one, than from any other *Point* of
its *Superficies*, by which means infinite *Rays* are
extended to every part of the *Body* it illumina-
tes.

VII.
What is
required
to the Pro-
duction of
Light.

To the Production therefore of *Light*, is re-
quired, *First*, *Matter* very swiftly agitated, as is
that which is in the *Center* of every *Vortex*.
Secondly, A certain *Matter* that is shaken, as is
that *Matter* which is about the *Stars*, that is, the
Globuli. *Thirdly*, It is requisite that this *Matter*
be shaken or vibrated in *Right lines*, or such as are
equipollent to *Right ones*: For tho' in all *Diapha-
nous Bodies*, the *Pores* are not *Mathematically
strait*; yet are they sufficiently so, for the trans-
mission of the *Action* of *Light*. *Fourthly*, That
this *Vibration* of the *Matter* be such, that by
Moving the *Nerves* the *Soul* may be excited to
that perception we call *Sense*; for it is our *Soul*,
and not the *Body* that is *sensible*. When therefore
either the *Organ* is unfit to receive this *Vibration*,

or that it be affected by any stronger *Vibration*,
the *Sensation* will be thereby hindered. And this is
the reason, why after the *Sun* is *risen* we cannot see
the *Stars*; because the stronger *Vibration* of the
Sun, renders the weaker *Vibration* of the *Stars*
imperceptible, except it be in case of some very
great *Eclipse*.

Tho' the *Light* diffuse it self on every side, and
equally drive before it the adjacent *Matter*; yet
is its *Action* lessen'd according to the *Degrees* of
its elongation from the *Luminous Body*. The bet-
ter to comprehend this, suppose we the *Tube ABC*
here decypher'd, enlarging it self by *degrees* to
contain *Water* as high as *DE*; and let afterwards,
by means of a *Spring*, so much *new Water* be
spouted into it by the *Hole A*, as may be sufficient
to fill the *Space AFG*, which tho' it be of some
height, yet it hath but little breadth; it will hence
appear, that by the accession of this *New Water*,
the *Water* contained in the *Tube* will be sensibly
rais'd a little higher towards *HI*, but not toward
DE. By which *Example*, the Nature of *Light*
is fitly illustrated: For as we cannot say, that the
Water above *DE* is not rais'd higher at all, but
only that it is rais'd very little; so in like manner
we must say, that the farther the *Beams* of *Light*
recede from the *Luminous Body*, the weaker and
less their *motion* is.

As a *Body* that is in *motion* upon meeting with
another *Body* that resists it, doth lose its determi-
nation, and is forced to turn aside; as we experi-
ence in a *Ball*, which being struck against a
Wall, rebounds; so we are to conceive, that the
Light meeting with some *hard Body*, is by it re-
verberated. For seeing that *Light* is nothing else
but a *pression* of the *Globuli* of the *Second Ele-
ment*, which tho' in the *Pores* of *Water*, *Air*,
Glass, and other such like *Bodies*, do touch one
another in various *ranks* or *rows*: Suppose the
Globuli that constitute the *Row CD*, to represent
those Parts of the *Second Element* that constitute
one *Ray*, falling upon the *hard Body AB*; it is
necessary that the *Action* of this *Ray*, be conti-
nued by the *Line DE*, towards *E*, that so the
Angle of *Reflexion* *BDE*, may be equal to the
Angle of *Incidence* *ADC*; that is, this *Action*
must be transmitted by the very same *Lines*, which
the *Globulus C* would describe, in case it were
alone, and were moved by the *Line CD*: For it
is manifest, that the *Globulus D* is disposed to
move onwards that way it would really move, if
its Power were reduced to act. And because this
Globulus, by meeting with the *Body AB*, would
neither tend towards *G* nor *H*, but only towards *F*,
it is evident that the *Globulus F* only is push'd
forwards by it, and that that alone receives its
Action. This is confirm'd by daily Experience,
for we find that the *Sun-beams* falling upon the
Surface of any *Compact Body* (as *Gold*, or *Steel*)
are reverberated, and that the *Light's* *Angle* of
Reflexion, is equal to the *Angle* of *Incidence*.

I know no *Body* that hath better explained the
nature of *Light* than our *Author*: And tho' they who
maintain *Light* to be *Fire*, do support their Opini-
on by strong *Arguments*, yet they struggle with
many difficulties, which are of no force against
our *Opinion*. For according to their *Hypothesis*
two *Bodies* would be in one place, if *Light* and
Fire were one and the same thing. Again there

VIII.
The far-
ther the
Beams of
Light
withdraw
from the
Luminous
Body, the
less and
weaker
they grow.

Figure
24.

IX.
How the
Light must
be reflected
upon its
meeting
with some
Bodies.

Figure
25.

X.
Light can-
not be Fire.

are many things that give *Light* without imparting *Heat*. Moreover, what shall we say becomes of the *Light*, when the *Sun* leaves our *Hemisphere*? shall we suppose that such a vast *Body* can perish in a moment? And lastly, how can the *Light* without interruption or disturbance reach our *Eyes*, when the *Air* is shaken by *Winds*, seeing one *Body* always resists another? And other such like difficulties that may be urged against the *Light's* being *Fire*.

IX.
No inconveniences follow upon supposing *Light* to be *Motion*.

But by constituting the nature of *Light*, in the *Pression* of the *Subtil matter*, we are delivered from the *Danger* of *Penetration* of *Dimensions*: neither are we necessitated to admit that *Light*, is always in conjunction with *Heat*; forasmuch as the *matter* of the first *Element*, can withdraw from the *Center* of the *Lucid Body*, and push forwards the *Globuli* of the second, which compass it about without producing the effect of *Heat*, as appears in *Glow-worms* and *Rotten-wood*. Neither are we pinched by that *Question* which demands, what becomes of the *Light* when the *Sun* withdraws from our *Hemisphere*, seeing we maintain the *Light* to be no more than *motion*, which cannot but cease as soon as the cause vanisheth. Neither needs the objection of the *Air* tost with *Winds* to trouble us, forasmuch as the *Intervals*, which we conceive to be between the *Parts* of *Bodies*, are fill'd with the *Subtil matter*, and are always open for the *Globuli* of the second *Element*, so that nothing hinders the *Light* from coming to us in a *Right Line*.

XII.
How *Light* is transferred in a *Moment*.

There is one difficulty only which seems somewhat to affect us, viz. how the *Light* of the *Sun*, and fixt *Stars* can reach our *Eyes* in a moment; yet even this also will be removed, if we consider, that the nature of *Light* doth not consist in the *Duration* of *Motion*, but that it is only a *Subitaneous Action*, directed to our *Eyes*, through the *Pores* of the *Air* and other *Diaphanous Bodies*; much after the same manner, as we by night with a *Stick* can discern and distinguish between *Water*, *Clay*, *Stones* and such like: For we then experience that the same *Action*, wherewith the end of the *Stick* toucheth the *Body*, is at the same instant felt at the *Head* of the *Stick*: And which would be the same were the *Stick* never so long, as might be demonstrated by many Examples.

XIII.
An objection answered.

If it be objected, that the *matter* of the second *Element* being *Fluid*, a Range of its little *Pellets* reaching from the *Sun* to our *Eyes*, cannot have the same effect in pushing forwards in a *right Line* as a *Stick* would and must have; for the more round and slippery these *Pellets* are, the more apt they are to slide away, and by this means to make the impulsion of no effect. To this I answer, that tho' the *matter* of the second *Element* be the most *Fluid* of all matters, yet this doth not hinder but that a Rank of them, reaching from the *Sun* to our *Eyes*, may be as effectual in pushing, as an inflexible stiff *Line*: For the *World* being every where full, every Ray of *Light*, hath always many others about it, which hinder it from sliding away, and consequently transmits the *Action* of the *Lucid Body*, in the self same manner as if it were a stiff *Stick*.

XIV.
In the Transmissi-
on of
Light there

You'll say, that no *Motion* can be made in an instant. We grant it, for in that *Motion* wherein the *Action* of *Light* consists, no *Body* is transmitt- ed, but the *Motion* only is transferred from one

Body to another. For the *Sun*, who is the *Principle* and *Fountain* of *Light* is not transmitted to our *Eyes*, but its *motion* only is continued to our *Eyes*, by means of the *Subtil matter*, which fills the *Pores* of the *Air*, and other *Pellucid Bodies*. Nor is it any contradiction that a *motion* should be transmitted in an instant, tho' no *motion* can be made in an instant.

From what hath been said, it may be clearly understood, how that *Action*, wherein we conceive the nature of *Light* to consist, spreads and diffu- seth it self every where from the *Body* of the *Sun* and fixt *Stars*, and how in the least moment of time it extends it self to the farthest distance; and to *Right Lines*, not only from the *Center* of the *Lucid Body*, but as well from any other *Points* of its *Surface*: Whence all other Properties of *Light* may be deduced. And I may add further, which will seem to some a great *Paradox*, that all these things would happen in the *Heavenly matter*, tho' there were no force at all in the *Sun* or any other *Star*, about which it was whirled: So that if the *Body* of the *Sun*, were nothing else but an empty *Space*, yet should we perceive his *Light* as well as now we do, (tho' it would not be so strong) at least in that *Circle* wherein the *Heavenly matter* is moved.

Some, it may be, will object that *Des Cartes* makes *Light* to be nothing else, but an *Aptitude* to *motion*; as when he saith *Dioptric. Cap. 1. that Light is nothing else, but the Action of the Celestial matter, or a Propension to motion*. Now if it be only a *Propension* to *motion*, it is no *motion*, and therefore the *Light*, which he saith, is received in the most *Subtil matter*, that fillsthe *Pores* of other *Bodies*, will never be produc'd, as long as it hath only a *Propension* to push forwards the same. Whence we must conclude, that if *Light* be an *Action*, and that such an one, as tends to the pro- duction of *motion*, *Light* must be before *motion*; for every cause is before its effect, and therefore *Light* cannot be *motion*.

This difficulty will be easily cleared, by distin- guishing betwixt *Light* in its *Fountain* or *Princi- ple*, such as are *Lucid Bodies*; and *Light* in a *Me- dium*, that is, any *Transparent Bodies*. The *Pro- pension* to *motion*, or *pression* which is in the *Lu- cid Body*, as the *Fountain*, is properly called *Lux*: But when considered in its progress, that is, in the *Heaven*, or the *matter* of the second *Element*, then it is called *Lumen*, tho' *Authors* commonly con- found both these words, using them promiscuou- sly; *Lux* therefore, or *Light* in its *Fountain*, is a *Propension* to *motion*; or is that *Action* in *Lucid Bodies*, which tends to produce some *motion* in *Transparent Bodies*, which is *Lumen* or *Light* in a *Medium*. Neither doth it imply any absurdity to say, that *Light* in the *Fountain*, preceeds *Light* in the *Medium*, since every cause is before its effect. The *motion* therefore which is in *Lucid Bodies*, produceth another *motion*, that is, *Light* in the *Air*, and other *Pellucid Bodies*.

It may be you'll urge, that if *Light* be that *A- ction* or *Motion*, whereby the *Sun* or any other *Lucid Body* pusheth forwards the *Subtil matter*, which is in *Transparent Bodies*, then the *Sun* must be conceived to be before that *Action*, and by con- sequent would be destitute of all *Light*; every cause being before its effect.

But

is no Trans-
lation of a
Body.

XV.
How the
solar *Light*
might ap-
pear though
there were
no *Sun*.

XVI.
How *Des*
Cartes is
to be under-
stood, when
he saith
that *Light*
is only a
Propension
to *motion*.

XVII.
The distin-
ction of
Lux and
Lumen, or
Light in
its *Foun-
tain*, and
Light in
the *Me-
di-
um*.

XVIII.
The *Sun* is
not before
the *Light*.

X.
The answer

But I answer, that this doth not follow, because the *Light* it self, or that *motion*, whereby the *Sun* doth circularly push forwards the *Subtil matter* whereof it is composed, is natural to it, and therefore it is not necessary, that as an *Efficient cause* it should be before it. Forasmuch therefore as the *Sun* is composed of the most *Fluid matter*, which is wholly whirled about its *Center*, it is necessary according to the *Rules of motion*, that it press the *matter* of which the *Heaven* is made, that is, the *Subtil matter*, which from the *Stars*, reacheth to our *Eyes*; in which *Action*, the nature of *Light* consists.

CHAP. XVI.

How Spots come to be Generated about the Sun, and fixt Stars, and how they vanish again.

I.
Went the Spots of the Sun are and who was the first discoverer of them.

BY the Spots of the *Sun*, we understand those close or compact Bodies, consisting of gross and flow Particles, mixt with others that are more Thin and Subtil, which since they cannot comply with the motion of a more subtil matter, are cast out from it; and by reason of their slower motion, clinging together about the Surface of the *Sun*, continue there for some time, and follow the *Sun's* motion, according to the course of the *Eclipsick*, till by the *Sun's* force they be dissolved, or sucked in again by it, or wholly expell'd from it. The first Observer and Discoverer of these Spots was *GALILÆUS*, in the year 1610, when he was *Mathematick Professor* in the University of *Padua*; and asserted them to be contiguous to the Body of the *Sun*, and that they moved round it, or rather were whirled about by the *Solar Globe* in the Space of 26 or 27 Days.

II.
The Colour and Figure of the Solar Spots.

The Spots of the *Sun* appear for the most part of a *Black-colour*, and are commonly surrounded with a *Darkish cloud*, which in the inside is more *Bright* than it appears on the outside. They vary their *Figures*; as appears by that Spot which was first discovered by the Famous *CASSINUS* in 1672, and which appeared 36 or 37 Days. These Spots are moved more slowly from the Eastern part of the *Sun*, to the West, and pass from one brim to the other in about 13 Days time. Their motion is found to be more swift near the Center; and they seem to make as great way in that part in 4 Days, as they do in 9 or 10 Days when they are near the Circumference. They appear likewise bigger in the Center, but near the Circumference long and narrow. From this their swifter motion near the Center, it is concluded either that they cling to the *Sun*, or at least are very near to him.

III.
How these Spots are formed.

Now as to the manner of their Formation we are to note, that the Particles of the first Element are not all of them of the same Bigness and Figure; and tho' we conceive them to be very Little, yet withal we must conclude some of them to be corner'd, and not so fit for motion, if we consider the Spaces or Intervals of the Globuli through which they pass: For these Spaces being mostly Triangular, they by passing through them get the same Figure, not much unlike the form of a Screw, as hath been before observed: By which means it is, that they cannot move so swiftly as

before, but do as it were rest or lye still, with respect to others that are more swiftly moved, and so more easily cling together. For tho' they retain the name of the first Element, as long as they continue between the Globuli of the second Element, because then being yet in their swift course, they only fill up the Spaces that are betwixt the Globuli, without composing any grosser Bodies: Yet they obtain the name of the third Element, when they come near to the Body of the *Sun*, especially the more gross and slowly moved Particles; for seeing they cannot comply with the motion of the rest of the subtil Matter of the first Element, they are cast out from it, and by running together into great Lumps or masses, they obscure and at last wholly hide the *Star*, from whence they came forth; for by clinging to its Surface, they darken and obstruct the *Light* proceeding from it, and hinder it from pushing forwards the subtil Matter in right Lines, wherein the force of *Light* doth consist.

Some Spots are more Solid, and very compact, as are those which run round the *Sun*; others are more thin, and therefore dissipable, such as are those which sometimes appear about the *Sun*, and then vanish again:

For as we see that *Water* or *Oil* boiling in a pot, doth cast off those Particles that are less fit for motion, and raise them up to the Surface, reducing them into Scum: So the *Sun*, whose matter is agitated with a fervent Heat, doth cast off from it, those grosser and many corner'd Particles, which cannot accommodate themselves to the motions of others, and these afterwards running together, constitute a kind of Scum, and so obstruct the *Light*. Which then more especially happens, when the *Sun* darts his Rays more forceably against them, for by this means, they are driven more closely together, and become more compact.

By this means it may happen, that a Spot which at first is Soft and very thin, may at last grow to that hardness, as to stop the passage of the *Sun's* Rays. Thus *Historians* assure us, that the *Sun* hath been seen for many days together of a Pale colour, not much exceeding the weak and dim Light of the *Moon*. Neither, in my Judgment, is there any other reason assignable, why some Stars appear now greater, and at other times less, but because their Aspect is varied, according to the diversity of Spots that surround them: Yea, they may sometimes become so totally cover'd by them, that for many years they may be hid from us. So formerly the Constellation of the *Pleiades* consisted of 7 Stars, whereas now 6 only can be seen.

And on the contrary it sometimes happens, that a *Star* not seen before, all on a sudden appears to the World: Which is when the Vortex wherein the Spot is, by pressing the Neighbouring Vortexes more strongly, than they press it, doth enlarge its Bounds; by which means the Matter of the first Element, rushing in more abundantly, to the obscured *Star*, diffuseteth it self over the Surface of the Spot; as *Water* is seen sometimes to overflow the Ice: and then the *Star* shines forth as Bright as if it had no Spot at all to darken it. According to this Hypothesis, we may understand how the New *Star* came to appear in *Cassiopeia* in the year 1572, which continued for 2 years, but appeared

IV.
Spots are of two sorts

V.
Spots like a kind of Scum, stick to the Star whence they proceed.

VI.
The Sun appears sometimes more dim and obscure because of the interposition of his Spots.

VII.
How a new Star may suddenly appear.

VIII.
How these
Spots are
sometimes
turned into
Torches.

appeared greatest at first, and afterwards being darkened by Degrees, at last wholly vanished.

It also happens sometimes, that the *solar Matter* flowing about the *Spots* wherewith it is coverd, doth rise above or beyond them, which *Matter* being thus pent up between them, and the *Surface* of the *Neighbouring Heaven*, is made to move more swiftly; as a *River* that is straitned in its passage doth run with more violence. And for this reason it is, that often *Torches* or *bright Flames* have been seen where formerly *Spots* appeared; and so on the contrary, the parts of *Spots* beginning to appear again, *Spots* have been seen where formerly *Torches* appeared.

IX.
Why the
Spots about
the Sun
move so
slowly.

The *Spots* about the *Sun*, take up no less time than 26 Days in running round it, notwithstanding they are so near to the *Body* of it; which *slowness* of their *motion* proceeds chiefly from hence, that a kind of *Aether* is generated, of the *Striate Matter* which the *Sun* continually casts forth, which extending it self a great way towards the *Orb* of *Mercury*, doth hinder the *motion* of the *Maculae*.

X.
The Cause
of the
Darkness
which hap-
ped at the
Death of
Christ.

It doth not appear by *Authors*, whether the whole *Earth* was darkned at the Death of *Christ*, or the *Holy Land* only: But supposing (as it is most probable) that the whole *Earth* was obscured (as the *Scripture* seems to assert, and *Dionysius* the *Arcopagite* does plainly witness, who was a Spectator of this wonderful *Eclipse* at *Heliopolis* in *Egypt*) the cause of this Obscuration can't be attributed to any thing better than to these *Spots*. Seeing it is possible for one *Spot* to spread it self over the whole *Surface* of the *Sun*, and to continue there for some time, before it be dispers'd again. And forasmuch as the *Body* of the *Moon* is much less than that of the *Sun*, we must conclude, that this total Obscuration could not proceed from the *Moon* alone, without the assistance of these *Solar Maculae*, or *Spots*.

XI.
The Moon
assisted in
the obscu-
ration of
the Sun,
at our
Saviour's
Death.

I will not deny, but this famous *Eclipse* might be caused by the intervention of the *Moons Body*, notwithstanding that it hapned at the time of the *Full Moon*. It appeared so to *St. DENYS*, as he testifies in his *Epistle* to *Polycarpus*: *Whilst I was* (saith he) *at Heliopolis in Egypt, I beyond all expectation saw the Moon upon the Body of the Sun.* Whereupon, as being astonished at this *Prodigy*, he cried out, *Either the God of Nature suffers, or the Frame of this World is dissolving.* But then, because the *Body* of the *Moon* was not great enough to effect a total obscuration, the *Solar Spots* came to its assistance, and wholly cover'd the *Sun* for three Hours together.

XII.
How these
Spots come
to disap-
pear again

As these *Spots* are generated, so in like manner are they dissolved again and vanish. For as *Oil* and other *Liquors*, do after some time suck into themselves again the *Scum* that hath cover'd their *Surface*; so likewise the *Striate Particles*, that cover the *face* of the *Sun*, in process of time grow less; and as they at first came from it, so they return to the *Sun* again. Except the thickness of the *Parts*, into which they are resolv'd, be such, that they are not able to pass through the *Globuli*, that are near the *Sun*; and therefore are forc'd to wander about, and disperse themselves in the adjacent *Heaven*.

C H A P. XVII.

Concerning C O M E T S.

C O M E T S are certain *Bodies* appearing amongst the *Stars*, in the utmost part of our *Heaven*, and that in various *Forms*, and in bigness resembling *Mars*, *Jupiter*, or *Saturn*, when they are cover'd with a *Mist* or *little Cloud*. They are compos'd of the *Parts* of the *Third Element*, and are so solid, that after they have for some time been swiftly carried in our *Heaven*, they are cast off into some of the *Neighbouring Vortexes* of the *Second Heaven*, and so disappear to us. They are sometimes called *Hairy Stars*, because of *Beams* like *Hair* proceeding from them, by which they are distinguish'd from the *Planets*, which appear exactly Round.

The *Comets* therefore agree with the *Planets*, in that both *Planets* and *Comets* are Vast, Round, Opaque *Bodies*, flowing or swimming in the *Heaven*. And they differ, in that *Planets* are less solid than *Comets*, and therefore not capable of so great agitation, as whereby they may be driven out of the *Sun's Vortex*, into other *Neighbouring Vortexes*; as *Comets* which have a stronger impulse, by reason of their greater solidity, do continually pass out of one *Vortex* into another.

The *Peripaticks* rank *Comets* amongst *Fiery Meteors*, and therefore attribute their *Generation* to *Exhalations* arising from the *Earth*, and kindled in the upper *Region* of the *Air*; but the *Modern Philosophers* are of a different Opinion, and that for these following Reasons.

First, Because *Comets* are in the *Heaven*, and not in the *Air*, as being observ'd to have either no *Parallax* at all, or a very small one, that is, less than the *Moon*, and consequently must be at a greater distance from us than she is: For the lesser the *Parallax* of any *Star* is, the greater is the Distance.

Secondly, *Comets* cannot consist of *Earthly Exhalations*, because they are bigger than the *Earth* it self: For their appearing *Diameter* (their Distance consider'd) is oftentimes greater than the *Diameter* of any of the *Planets*. The appearing *Diameter* is different, according to the Distance of the *Body*, as being Smaller in a less Distance, and Greater in a greater Distance.

Thirdly, If *Comets* were kindled *Exhalations*, no reason could be given why they should not decrease daily, as their *fuel* decreaseth; whereas we find that they all increase and decrease after one and the same manner: For they are less at the Beginning and End of their appearing, and biggest in the Midst. But because some relate, that *Sublunary Comets* have at some times appeared, we will distinguish *Comets* into *Bastard* and *True*.

We call those *Bastard Comets*, which are compos'd of *Earthly Exhalations*, raised into the upper *Region* of the *Air*, and there kindled. But *True Comets* are such as are above the *Moon*, and which shine by reflecting of the *Sun's Beams*, not by being kindled into a *Flame*. Those of the first kind, if any such be, are *Meteors*; but the latter are all *wandering Stars*.

A *Comet* therefore is a *Wandering Star*, compos'd of the *Matter* of the *Third Element*, which because of its solidity and great agitation passeth from

I.
The Nature
of Comets.

II.
How Co-
mets agree
with, and
differ from
Planets.

III.
The Peripa-
ticks sup-
pose Comets
to consist of
Earthly Exha-
lations.

IV.
Reasons
against the
fore said
Opinion.

V.
The distinc-
tion of
Bastard
and true
Comets.

VI.
What a
Comet is.



To the Worship-
of Thorp-underwood
Northampton
This Plate is humbly



-full Andrew Lant
in the County of
Esq.
Dedicated by Richard Blome



from one Vortex to another. I take both Comets and Planets to be perpetual Bodies, made in the Beginning of the World, and continually tost between the Superiour or utmost parts of the Vortexes.

VII. The Original of Comets. But to the end we may the better understand the Original of Comets (in case we should suppose any of them to be produc'd anew) we are to remember, that the Matter of the First Element, which from other adjacent Vortexes, passeth thro' the Poles into the Center of our Vortex, doth carry along with it many striate Particles, which being unfit to comply with the swift agitation of the subtil Matter, are cast forth; which afterwards, because of the inequality of their Figures easily cling and stick fast together, and by this means come to constitute great Masses, and being close to the Star from whence they proceed, resist the Action, wherein the Nature of Light consists; and in this respect, are very like those Spots about the Sun, which we have already spoken of.

VIII. How a fixed star becomes changed into a Comet. Now, whenever it happens that a Star is cover'd with so many and thick Spots, as that its Vortex becomes swallow'd up of other adjacent Vortexes: Then if it be so solid, that before it comes to that Term or Limit, where the parts of the Vortex are most slowly moved, it happens to acquire a motion equal to that of those Parts amongst which it is, in this case it descends no lower, but from this Vortex passeth into others, and becomes a Comet. But if it be less solid, and consequently descends beneath that Bound, then it continues there at a certain distance from the Star, which is in the Center of that Vortex, and whirls round about it, and by this means becomes a Planet. For this is the difference betwixt a Comet and a Planet, that a Comet being more solid, is carried from one Vortex into another; whereas a Planet continues fix'd to one Vortex, and is obsequious to its motion.

IX. The Air is not the Place of Comets. Tho' Modern Authors be much of the same mind with one another about the Substance of Comets; yet are they at great Variance about the Place of them. Some will have them generated in the Third Region of the Air, as being of Opinion, that the Exhalations, of which they suppose Comets are made, cannot ascend higher. But this Opinion, as hath already been made out, is not probable; forasmuch as the same Comet, is at the same time perceived in divers very remote Parts of the World, especially that of the Year 1618, which was seen in Europe, and in the East-Indies, which could not have been, had its place been in the Air.

X. They run round the Earth in 24 Hours. Besides, Comets commonly compass the whole Earth in 24 Hours time, and are observ'd to make the same Ray above, as under the Horizon. All which may easily convince us, that they must be above the Air. For the Earth is not far distant from the Circle of the Air, and compar'd with it, hath a considerable Magnitude; so that if from its Surface we should divide the Air into two Halves, they would not be equal, but the Half hid from our sight, would far exceed the other; and accordingly a Comet would longer continue under, than above the Horizon; which we find not to be so.

XI. The Place of the Co. Comets therefore are to be placed in that Space, which is between Saturn and the fix'd Stars; as

appears by their Excursions, and other of their Appearances. Neither can they be placed amongst the Planets, forasmuch as they are Regular in their Motion about the Sun, and never wander out of their Spheres. And by this means we may easily apprehend, how Comets absolve their Revolution in 24 Hours time, and continue no longer under, than above our Horizon; because the Bigness of the Earth being inconsiderable, with respect to that Space they move in, we may well enough divide the Circle of the Air into two equal Halves.

And tho' Tycho, and other Astronomers, who have accurately observ'd their Appearances, have only said, that they were above the Moon, towards the Spheres of Venus or Mercury, and not above Saturn, (tho' they might as well have concluded, that from their Calculations;) the Reason whereof was, because they disputed against the Ancients, who took the Comets to be Meteors, and therefore were content to shew that they were in the Heavens, and were loath to attribute to them all the height, which they had found out by their Calculations, lest they should be disbelieved, by advancing such incredible Paradoxes.

Put forasmuch as the Space which is between Saturn and the fix'd Stars, is Immense; we say that Comets, how great soever they may be, cannot be seen by us, if they be far distant from our Heaven; for the Light which they borrow from the Sun is very weak, neither have they force enough, at such a distance, to affect our Sight. Which is the Reason, that when they approach to the fix'd Stars, they disappear; or if their Body appear, yet their Tail is hid. But the fix'd Stars, which are beyond them, easily transmit their Light to us, because they have a Light of their own, which makes them dart their Rays more strongly; whereas Comets that shine only with a borrowed Light, must be in our Heaven, to be seen by us.

XIV. How the Comets are moved. The Comets do all of them seem to move about the Earth from East to West, and in this their Motion they describe Circles almost parallel to the Equator. But besides this apparent Motion, which is common with them to all the rest of the Stars, they have another that is peculiar and proper to themselves, but very irregular and indeterminate, by which some of them move from East to West, others from West to East, or to other Coasts of the Heavens. Neither can their Course be said to be Regular, but rather various and unequal, since some of them pass through a greater Space of Heaven than others. But however Great this Space may be, there are but few of them that ever were perceived to run through above one Half of the Heaven.

XV. What the Beard, Tail, and Hair of Comets is. When a Comet casts its Rays towards that part of the Heaven, whither it is carried by its own Motion, such Rays are commonly called a Beard; but when they tend to that part from whence it tends, then are they called the Comets Tail; and when they are cast forth circularly, we call them Hair, or a Rose.

XVI. The Cause of these Appearances. It will not be difficult to give a Reason of these Phenomena, if we call to mind that the Heavens Globuli of the Vortex wherein we live, are by so much less, as they draw nearer to the Center; and by degrees grow greater and greater until the Sphere

Comets that wander out of our Heaven, are no longer seen by us.

XII. Why some Astronomers say, that Comets are only above the Moon.

XIII. Comets that wander out of our Heaven, are no longer seen by us.

XIV. How the Comets are moved.

XV. What the Beard, Tail, and Hair of Comets is.

XVI. The Cause of these Appearances.

Sphere of Saturn, where they are of an equal bigness, and are more swiftly moved. When therefore a Comet, taking its Course beyond the Region of Saturn, transmits the Rays it receives from the Sun to us, it at the same time pushes forwards the Globuli of the Second Element in Right lines to our Eyes, which imparting their active Force to others that are under them, produce an entire and pure Light, which makes the Head or Body of the Comet to appear to us: Whereas those which fall obliquely upon the little Globuli that are beneath, or on the sides of them, are partly refracted, and so represent a Beard or Tail to us. But those which are dispers'd round about on all sides, exhibit Hair, or a Rose. For the variety of all these Appearances proceeds only from the Reflexion of the Rays of Light upon the Comet; which having been refracted by passing through the Heavenly Globuli, are so received into our Eyes, as if they came from those parts, where we think we perceive the Beard, Hair, or Tail of the Comet.

Thus the Globuli of the Second Element, 3, 2, 1, 9, 7, which are extended from the Sun to the utmost Bound of the Sphere of Saturn H, C, I, are very small, whereas those that go beyond that Sphere H, F, A, 4, 5, 6, I, do exceed them in Bigness; so that each of the greater Globuli, that are in the utmost part of the Sphere of Saturn, may be surrounded by 7 or 8 of the smaller Globuli that are lower. And forasmuch as the greater Globuli, falling perpendicularly upon the Sphere of Saturn, do push upon few of those that are under them, they must necessarily produce only a weak Refraction of Light; whereas on the contrary, those that fall obliquely upon it, since they have many little ones on one side of them, must needs make a greater Refraction of weak Rays. As for Example; the Greater Globulus C, falling perpendicularly on the little ones that are under it, hath only 2 Globuli, viz. 1 and 3 on each side, and therefore both ways produceth small Refractions, deflecting from the Perpendicular C B, whereof the one is only directed from C to D, but the other from C to E: But the greater Globuli H and I, falling obliquely on the lesser, do push forwards 6 or 7 of them, viz. those that lye under them; and therefore the greater Globulus I, produceth a considerable Refraction from I unto B, deflecting from the Perpendicular I K; and so likewise the great Globulus H, makes a great Refraction from H, to B, deflecting from the Perpendicular H G.

Hence it appears how Comets come to appear with Tails, Hair, or like Beams. For let us suppose the Sun to be S, and the Sphere through which the Earth is supposed to be carried in 24 Hours time, to be 2, 3, 4, 5; the Term from whence the Heavenly Globuli begin to grow less and less by degrees till they reach the Sun, to be D, E, F, G, H, and C, to be the Comet plac'd in our Heaven; it is manifest that the Rays of the Sun are not only reflected from the Comet in the Right lines C F 3, C H 6, C G 4, C E 2, and C D 7; but that they are also refracted side-ways, and dispers'd; so that according to the various Position 2, 3, 4, 5, of the Spectator upon the Globe of the Earth, the Comet seems either to have a Tail, as in 2 and 4; for

by means of the direct Rays C, G 4, or C, E, 2, the Body or the Head of the Comet appears to us, and by the help of the refracted and weaker Rays, its Tail or Hair is discovered by us: Or with Hair, as in 3; for its Head is seen by us, by means of the strong and direct Rays C, F, 3; and by the Refracted and weaker on one side of it, C, G, 3, and on the other C, E, 3, we see the Hair of the Comet: Or nothing but its Tail is seen by us in the form of a fiery Beam, as in that part of the Sphere of the Earth 5, by means only of the weaker and refracted Rays C, D, 2, 5, or C, H, 4, 5; because no other Rays can reach the Eye of the Beholder, as long as he is posited in that part of the Terrestrial Orb, marked 5.

And from what hath been laid down, a Reason may be also given of all the other Phenomena of Comets. As,

First, Why they appear rarely, and not at set times or seasons.

Secondly, Why they do not move long in our sight.

Thirdly, Why they seem to be less at the Beginning, greatest in the Midst of their Course, and afterwards grow less and less by degrees. Which happens, because at first they are further from us; in the middle of their Course, nearer, and in a fitter condition to reflect their Rays; and towards the end of their Course, again more remote from us.

Fourthly, Why their Motion at the beginning is slower, in the middle swifter, and at the end slowest of all. The Cause whereof is, because the Comet at its first ingress meets with some Resistance, because of the Renitency of the Vortex, from whose Force it afterwards receives power to move more swiftly; and towards the end of its Course it is resisted by the Neighbouring Heaven, towards which it tends.

If any demand, why no Hair appears about Jupiter and Saturn, as well as about the Comets? I answer, That sometime there is a kind of appearance of short Hair seen about them, in that part which is opposite to the Sun, in places where the Air is very pure and clear. Wherefore, when ARISTOTLE saith, Lib. 10. Meteorologic. cap. 6. that the fix'd Stars have sometimes been seen, with Rays in the manner of Hair about them, I suppose it ought rather to be understood concerning these Planets. But as to that which he relates of the Hair, that appeared about one of the Stars in the Thigh of the Great Dog, it must have proceeded either from some very oblique Refraction in the Air, or rather from some fault or defect in his Eyes: For he adds, That it was less conspicuous when he fix'd his Eyes strongly upon it, than when he beheld it more remissly, and without any earnest intention.

C H A P. XVIII.

Of the Nature, Original, and Affections of Planets.

THE Planets are Various, Round, and Opaque Bodies, hanging in the Vortex of the Sun, and by it carried about the Sun, as a kind of a common Center of their Motions, receiving its Light, and variously conveying the same to our Eyes.

Figure 26.

XVII.
How Comets come to appear with Tails, Hair, and like Beams

Figure 27.

XVIII.
A Reason given of the various appearances of Comets.

XX.
Why no Hair appears about Saturn.

What the Planets are

II.
Their Num-
ber.

III.
Whether
the Sun
be to be
reckon'd
amongst
the Pla-
nets.

IV.
The Pla-
nets are
compound-
ed of the
Matter of
the Third
Element.

V.
They have
no Light
of their
own.

VI.
The Earth
is to be
accounted
amongst
the Pla-
nets.

Eyes. That they are solid and opaque *Bodies* *GALILÆUS* shews, who by the help of his *Tube* hath discover'd no less inequalities in the *Moon*, than we meet with in our *Earth*.

There be *Seven* of them, which are counted in this order; *Saturn*, *Jupiter*, *Mars*, the *Earth*, the *Moon*, *Venus* and *Mercury*.

The *SUN* is commonly counted to be one of the *Planets*, but by a mistake; for besides that the *Sun* is not an *Opake*, but a *Lucid Body*, nor hanging in another *Vortex*, but having its own proper *Vortex*; neither hath it likewise a *wandering Motion*, like the *Planets*, but is continually turn'd round in its own *Vortex*; and therefore cannot be reckon'd amongst the *Planets*.

The *Planets* were formed of the *Particles* of the *Third Element*, from the running together whereof they became great *Bodies*. For no sooner was *Motion* communicated to the several *Parts* of the *World*, but the *most subtil Parts* (made so by their rubbing against one another) constituted the *Sun* and *fix'd Stars*; the *Round parts* (which Roundness they obtain'd also by their running against each other) made the *Heavens*; and the *thicker and grosser Parts*, being by reason of the inequality of their *Figure*, less fit for *motion*, formed the *Seven Planets*; *h Saturn*, *4 Jupiter*, *δ Mars*, *T the Earth*, *γ the Moon*, *♀ Venus*, and *☿ Mercury*. So that the whole *Matter* of this visible *World* may aptly be divided into three General Heads of *Bodies*, viz. such as send forth *Light*, as the *Sun* and *fix'd Stars*; such as transmit *Light*, as the *Heavens*; and such as Reflect the *Light*, as the *Earth*, with the rest of the *Planets*.

For the *Planets* being destitute of all *Light* of their own, shine only with borrowed *Rays*; and accordingly we find them only to be resplendent on that side which faceth the *Sun*; whence we conclude, that they only reflect to our *Eyes* the *Rays* they receive from the *Sun*. This we experience in the *Earth*, *Mercury* and *Venus*, and all the *Secondary Planets*, which in *Eclipses* are either wholly or in part obscured, when they come within the *Shadows* of other *Planets*; and being out of the reach of them, do only spread a *Conical shadow* from their opposite part to the *Sun*. And we may believe the same of *Mars*, *Jupiter* and *Saturn*; which by how much nearer they are to the *Sun*, the greater *Light* do they cast; and so much the weaker, as their distance is farther from it. The same is also manifest from hence, because the *Light* of all the *Planets* is more dim, than that which is seen in the *Sun* and *fix'd Stars*; as likewise, because there is not so vast a distance between them and the *Sun*, but that he can communicate his *Light* to them.

And we are to suppose the same of this *Earth* we inhabit, which being made up of *Opake Bodies*, does as strongly reflect the *Sun's Rays*, as the *Moon* doth. It is also surrounded with *Clouds*, which tho' they be less *Opake* than many other *Parts*, and therefore do not so strongly reverberate the *Light*; yet we sometimes see them cover'd with as bright a *Whiteness*, as the *Moon* it self exhibits to us, when she is illustrated by the *Sun*. The same is also confirm'd, for that when the *Moon* intervenes between the *Sun* and the *Earth*, we see that its Face doth reflect a kind of obscure *Light*, which, as far as we can guess, must proceed

from the *Earth*, which reflects the *Beams* it receives from the *Sun* to the *Moon*. Which obscure *Light* sensibly decreaseth, as the illuminated part of the *Earth* turns away from it.

Tho' it cannot be doubted, but that the *Planets* are *Spherical Bodies*, like the *Earth* (for if they were of a plain figure, they would in one and the same moment be totally enlightned;) yet are they not so perfectly Round, but that their surface is very rough and uneven. For we find by the help of *Telescopes*, that they abound with *Cavities* and *Eminences*, corresponding to our highest *Hills* and deepest *Valleys*, (as *GALILÆUS* tells us concerning the *Moon*, *System. Cosm. Dial. prim.*) many whereof are continued for a Tract of an hundred Miles together; others again are single and compriz'd in one Heap. There appear also many steep and solitary *Rocks*. But the most frequent things to be seen there, are a kind of *Bulworks* (I call them so, because no fitter word occurs) of considerable Height, which encompass Spaces of different magnitude and figure, the most frequent being *Circular*. Many whereof have in the midst of them an *high Mountain*, and others seem to be filled with an obscure Matter, like those great *Spots*, which we may perceive in the *Moon*. From all which Particulars we conclude, that the *Moon* and the rest of the *Planets*, are altogether like our *Earth*, which if a Man could behold from the *Moon*, would appear much as the *Moon* shews to us, who view it from the *Earth*.

We are in the next place to consider how the *Planets* came to be, and what is the cause of their different Distance from the *Sun*, and from themselves. This will be the more easily cleared, if we consider, that the *Planets* are less solid than the *Comets*, and therefore are not tost from one *Vortex* to another, but continue in that of the *Sun*; as small *Boats* are driven about in a *Whirlpool*, or carried along with the Stream of a *River*. Whence we may apprehend, that the *Planets*, as soon as they were got into the *Sun's Vortex*, began to sink down towards the Center, till they met with those *Celestial Globuli*, whose motion was proportion'd with theirs. For seeing that the greater *Globuli* are more vehemently agitated, and withdraw themselves farther from the Center of their *Vortex*, it could not be, but that by their pushing against the *Planets* that are less solid, they must drive them towards the Midst; and when the *Planets* were sunk so low, that they met with those *Globuli* that were inferior to them in bigness and force of motion, they run back from the Center, till arriving to that place of the *Vortex* where they were in equal poise, they neither came nearer to the *Sun*, nor went farther from it; but hanging there equally poised between those *Heavenly Globuli*, whirl'd continually about the *Sun*.

Wherefore we may imagin, that in that Space where we place the great *Vortex* of our *Heaven*, there were at the Beginning 14. or more *Vortexes*, the less whereof, and such as were weakned by reason of their *Spots*, were swallowed up of the Greater; which at last, together with the Lesser, fell into one common *Vortex*, viz. that of the *Sun*. So that the *Stars*, which in the Centers of the four smaller *Vortexes*, encompass'd *Jupiter*, betook themselves to that *Planet*; and those which were in the Centers of other *Vortexes* near to *Saturn*,

U u

tended

VII.
The Pla-
nets are
not perfect-
ly Round.

VIII.
The Pla-
nets are
not so solid
as Comets.

IX.
Of the first
Production
of Planets.

tended towards *Saturn* ; as *Mercury*, *Venus*, the *Earth* and *Mars* tended towards the *Sun*. So that of so many *Stars*, all shining with their own light, the *Sun* only remained, whilst all the rest being covered with *Spots*, did not send forth light, but only reflect it.

X.
Why the
Planets are
at farther
distance
from, or
nearer to
the Sun.

It appears from what hath been said, why the *Planets* do not equally recede from the *Center*, and at different distances are carried about the *Sun*; this being to be imputed to their different solidity. For the *Globe* of *Mercury*, by Example, is nearer to the *Sun* than that of *Venus*, and the *Globe* of the *Earth* nearer than that of *Mars*, for no other reason but because they are less solid.

XI.
What the
Solidity of
Bodies is.

Now Solidity is nothing else, but the proper Quantity of a *Body* compared with its Bulk and Surface; which is not only estimated from the Closeness and Thickness of its parts, but also by its Figure, and especially from the less extent of its Surface. For *Bodies* of a less Surface, do more easily pierce other *Bodies*: and therefore the greater the quantity of matter is, under a less Bulk and Surface, the more solid that *Body* is. As appears in *Gold* and other *Metals*, which when once put in motion, have a greater force to continue the same, than more lax and open, or porous *Bodies* (as *Wood* and *Stone*) of the same Bigness and Figure; and therefore are esteemed more solid, that is, to have in them more matter of the Third Element, and less Pores filled with the First and Second Element. And this is the reason why *Mars*, tho' less than the *Earth*, yet is farther from the *Sun* than it, even because of its greater solidity.

XII.
The Planets
differ in
Solidity a-
mongst
themselves.

The *Planets* therefore, as hath been said, according to their greater or lesser Solidity, are farther from, or nearer to the *Sun*. By reason of this greater Solidity, *Saturn* is most remote from the *Sun*, whose Motion, if it had been swifter, and his Solidity greater, he would have been forced out of his Vortex, and become a *Comet*. Next to *Saturn* is *Jupiter*, with his four Secondary *Planets*, which we suppose did fall down into his Neighbourhood, before that Vortex, whose Center *Jupiter* was, had been swallowed up by the great Vortex of our Heaven. After him follows *Mars*, who, because of the extension of his Body, that is, his Magnitude and Figure, is more solid than the *Earth*. Next to him is the *Earth*, surrounded with its own Vortex, about which the *Moon* is whirl'd in a Months time. For the *Moon* tending towards the *Earth* (as the *Jovial Planets* towards that Planet) was swallowed up of its Vortex. *Venus* is nearer the *Sun* than either the *Earth* or the *Moon*, but the nearest of all is *Mercury*, as being the most solid of them all.

XIII.
The Planets
are either
Primary or
Secondary.

The *Planets* are divided into *Primary* and *Secondary*. *Primary Planets* are those that perform their Periodical motion only about the *Sun*, and not about any other Planet. *Secondary*, are such as are joined with another Planet, and together with it, are carried about the *Sun*. Thus the *Moon* is a *Secondary Planet* with regard to the *Earth*, the *Jovial Stars* with regard to *Jupiter*; and so are those other Stars that attend upon *Saturn*. By the *Astronomers* they are commonly called *Satellites*, or *Guards* of those *Planets* to which they belong.

C H A P. XIX.

Concerning the Principle of the Planets Motion, and of their Direction, Station and Retrogradation.

Seeing that the *Heavens* are Fluid, and that the *Planets* do, as it were, swim in their Orbs, as in so many *Rivers*, it may be enquir'd what is the Principle of their Motions; as likewise what the cause is of those wandering excursions, whence the name of *Wandering Stars* hath been given them. Which name, we may believe, was therefore attributed to them; for that being carried about in the *Sun's Vortex*, they seem sometimes to approach nearer to, and sometimes to remove farther from one another; sometimes to ascend, and at other times to descend; sometimes to come nearer to the *Sun*, and at other times to withdraw at a greater distance from him. Whence arise the *Conjunctions* and *Oppositions* of the *Planets*, as likewise their *Aberrations* in *Longitude* and *Latitude*, so often inculcated by *Astronomers*. For tho' the *Planets* turn round about the *Sun*, yet do not they keep on their Course in the same direct Line, but do sometimes ascend, and at other times descend, as we see *wooden Bowls* do that swim in a *River*. And this their Deflexion is called *Aberration* in *Latitude*. Or else they are sometimes nearer the *Sun*, and sometimes farther from him; which are called *Aberrations* in *Longitude*. And this is the Reason, I say, why the *Planets* are call'd *Wandering Stars*, because they seem to roam at random, without keeping a steady course.

This wandering motion of *Planets* may be attributed to several Causes. As First, to the Figure of those Spaces wherein they move; for these, not being perfectly Round, but spreading more in Length than Breadth, it must needs be that the *Heavenly Matter*, that carries them, must move more swiftly, where it is narrowly pent up, than where it hath a broader space to move in. As we see that the *Wind* blows with less force in an open Field, than where it is straitned in a narrow Passage; and as a *River* runs more swiftly where it is straitned in its course, than where the Charnel is wider.

In the second place, for as much as these Spaces do touch one another, the matter of the First Element, passing from one space to another, doth according to the different degree of its motion, variously push forwards, and determine the Globuli of the Second Element, to drive the *Planets* more towards one part of Heaven than another. For the matter of the First Element being more swiftly moved, than the Globuli of the Second, it cannot but by pushing them forwards, move the *Planets* that are poised in the midst of them.

Thirdly, This difference in the motion of *Planets*, sometimes ariseth from themselves, as when their pores are more fit to receive the particles of the First Element, proceeding from some Neighbouring Body, than others. Which sometimes also happens, when the Pores of *Planets* are more adapted to admit the striate Particles, which come driving from some certain part of the Heaven: For these particles being entred into the Cavity of the *Planets*, do variously agitate them, directing them towards those places to which they did tend. As the *Wind* turns a *Ship* to this or that part,

I.
Why the
Planets are
called Wan-
dering Stars.

II.
The First
Cause of
the wander-
ing motion
of the
Planets.

III.
The Second
Cause.

IV.
The Third
Cause.

part, according as it penetrates the pores of the Sails, or other open passages of the Vessel.

V.
The Fourth Cause.

Fourthly, The same Motion which in the beginning of the World was impress'd upon the Planets, may be preserv'd to this instant, seeing that every Body continues in the same state, and is never changed but by External Causes. Thus a Top that is made to turn round by a Boy, hath a force to continue the same motion for some moments, notwithstanding the resistance it meets from the Air and the Earth. And accordingly we may believe that a Planet likewise hath a power to pursue the motion impress'd upon it at the beginning, without any considerable loss of its swiftness; because the space of 5 or 6000 years, is a less time, compar'd with the vast bulk of a Planet, than one minute, compar'd with the littleness of a Top.

VI.
The Fifth Cause.

In the last place we may add, That the power of continuing in its motion is more firm and steady in the Planet, than in the Heavenly matter that surrounds it; and in a greater Planet more than in a less. Because the Globuli, which are the parts of a Fluid Body, cannot so well conspire in the same motion, as the Particles of the Third Element do, which constitute the Compact Body of a Planet. Wherefore also it must be less obnoxious to those changes that happen to the motion of the Celestial Globuli, by how much the greater and compact it is.

VII.
The Periodical and Daily Motion of the Planets.

Every Planet hath a twofold Motion; the first Periodical, whereby every one of the Primary Planets, together with its Attendants, is carried about the Sun: For that they are whirl'd about in their Orbs by the force of the Solar matter, appears from hence, because the nearer they are to the Sun, the sooner they absolve their Circuit: Not to mention now the motion of the Spots in the Sun, which, without doubt, proceeds from the whirling about of the Solar matter.

The other is the Diurnal motion, whereby a Planet seems in the space of 24 hours to move about the Earth from East to West. But this Motion doth not properly belong to the Planets, but is common to them with the Comets and Fixt Stars, by reason of the Diurnal motion of the Earth, as will appear hereafter.

VIII.
How the Planets are carried about by their Annual Motion.

A Planet therefore is whirl'd about its Center, much after the same manner, as we see that a Trencher swimming in a large Vessel full of Water, that is swiftly whirl'd about, doth not only follow the circular motion of the water, but besides turns about its own Center. The Famous CASSINUS observed this in 1672. in the Body of Jupiter: for he having observed a Spot at 7^h. a clock in the evening in the midst of the Belt, he found at 5 a clock 26 minutes in the morning, that it was return'd precisely to the same place. And therefore from this and many other observations, he determin'd not only the Revolution of the Spot, but also of the Body of Jupiter, which he found to be performed in 9 hours 55 minutes, and 58 seconds; and the same was perceived by him not only in Jupiter, but also in Mars, Venus and Mercury.

IX.
The Cause of these two Motions.

This twofold motion of the Planets ariseth from hence, because the Celestial Globuli that surround them, do not only carry them along their Orbs; but also because of the Propension they have, to pursue their motion in Right lines, they do more strongly exert their force upon their Ex-

ternal parts, that are more remote from the Sun, than upon their Inward parts that are nearer to it: by which force they impress that motion upon it, which makes it whirl about its own Center.

The Consequence whereof is, that the Inferior Planets, or those that are nearer the Sun, must move more swiftly than the Higher. Because the matter of the First Element, which constitutes the Sun, by being swiftly whirl'd about, doth with a greater force drive along with it, the nearest parts of Heaven, than those which are more remote.

These things presuppos'd, it will be an easie matter to explain the motions of the several Planets, and how it comes to pass that they seem to be carried from the East to the West. For supposing that the Heavenly matter that surrounds the Sun, is moved round it from West to East, and, without any interruption of its own Revolution, carries along with it the Earth about its Center in 24 hours; we shall easily conceive, that Mercury and Venus must appear to us to move from East to West, and every day to describe a Circle Parallel to the Equator. And that they must likewise describe a Circle about the Sun from West to East, as being contained in the same matter, that carries the Earth round.

We shall also apprehend that these two Planets, as well as the Earth, must be found under the Zodiac, because it is the greatest Circle, which the Celestial matter, by which they are carried about, describes. For as much as according to the Law of Nature, every Body that is circularly moved, endeavours to recede from the Center of the Circle it describes.

It will also appear how the Axis of the Earth, which by its Annual motion is carried about the Sun, continues always Parallel to it self, or which is the same, how its Poles always respect the same points of the Firmament, viz. If we observe that the Diurnal motion of the Globe of the Earth, Water and Air doth determinate the subtil matter, which is in continual motion in the Bowels of the Earth, to go forth to the Plains parallel to the Equator; and that at the same time, a like quantity of matter, proceeding from the parts of other Vortexes remote from the Poles, must enter into it by the Poles. For this suppos'd, it will easily be believed, that after the Earth hath once admitted the Subtil matter, coming to it from one part of the Heaven, its pores will thereby be the more fit to receive the like matter again, than any other proceeding from other parts, as being more accommodate to it. And therefore it is no wonder, if those Pores which we apprehend to be Parallel to the Axis of the Diurnal motion, are so hollowed as to answer one another, and thereby give free admittance to the subtil matter. Which being granted, it is necessary that the Poles of the Earth, must always answer the same points in the Firmament, and its Axis observe a perpetual Parallelism to it self.

And the same is to be said of Mars, Jupiter and Saturn: For seeing that these three Planets do seem so to run round the Sun, as that the Circles which they describe, do include the Circle of the Earth, we must admit that they are pois'd in the Celestial matter as well as the Earth, and are at a far greater distance from the Sun, than it is. In like manner we must confess that Mars, Jupiter and Saturn

X.
The Planets that are nearest to the Sun are most swiftly mov'd.

XI.
How it comes to pass that Mercury and Venus seem to turn about from East to West in 24 hours.

XII.
They must describe a great Circle.

XIII.
How it comes to pass that the Axis of the Earth observes its Parallelism.

XIV.
Mars, Jupiter and Saturn are mov'd like the other Planets.

Saturn must seem to run round the *Earth* from East to West in 24 hours, and to be carried away by the Heavenly matter, in the same manner as *Mercury*, *Venus* and the *Earth* are. Only with this Difference, that seeing their Circles are much greater than that of the *Earth*, so they employ a greater space of time in running through them. For whereas *Mercury* is whirl'd about the *Sun* in 3 Months, *Venus* in 8 Months, the *Earth* in a years time, *Mars* spends 2 years in his Revolution, *Jupiter* 12, and *Saturn* almost 30. For the distance between these three latter, and the *Sun* being greater, the matter which carries them, requires more time to run over those vastly greater Spaces.

XV.
How Planets come to be Direct, Stationary and Retrograde.

From these various Courses of the *Earth* and Planets in their Revolutions about the *Sun*, it comes to pass that they appear to us on the *Earth* Direct, Stationary and Retrograde. For tho' their motion be continual, without any stop or Retrogradation, yet doth the motion of the *Earth* produce these various appearances, as oft as in its Revolution it intervenes betwixt the Planets and the *Sun*. Because when the *Earth* is whirl'd about the same way, swifter than the Planets, we must see them answering to divers parts of the *Heaven* of fixt Stars, and to be carried opposite to that part, whither we, together with the *Earth*, are carried.

XVI.
What Planets are said to be Direct, Stationary and Retrograde

Those Planets therefore are called *Direct*, which pursue their Course according to the procession of the Celestial Signs; as from γ to δ , from δ to ϵ . Planets are said to be *Retrograde* when they proceed contrary to the Succession of the Signs; or which having first been moved towards the East, seem now to turn back towards the West: and those are called *Stationary*, which keep the same place under the fixt Stars for several days together. These Stations of the Planets, are observed before and after their Retrogradations, because the Determination of the motion of the *Earth*, doth deflect a little with respect to the Determination of the motion of the Planets, by which means the swiftness wherewith we are then snatcht away, doth only serve to advance us, as much as is needful, to behold that Planet which is Stationary, for several days together, under one and the same part of the Firmament.

XVII.
How Planets appear direct to us.

Figure 28.

The thing will be better apprehended by the Figure. Suppose we then the *Sun* placed in the midst of a Circle, about whom let us place the Circle $a d g k$, described by the Annual motion of the *Earth*. The other Higher Circle intersected by numeral figures, we suppose to be the Orb of some one Planet, viz. of *Mars*, *Jupiter* or *Saturn*, and the Circle NGA , to represent the *Heaven* of Fixt Stars. These things thus laid, let us suppose that the *Earth*, by its Annual motion is about the Point a , and that *Jupiter* is in that part of his Circle marked only by 1; then *Jupiter* will appear to those that dwell upon the *Earth*, in the part of the *Heaven* of fixt Stars, noted A , by the right line, $a 1 A$. Conceive we afterwards, the *Earth* to be advanced from a to b , and *Jupiter* from 1 to 2, at the same time; and *Jupiter* will appear to us to have moved on directly in the *Heaven*, according to the Order of the Signs from A to B ; and when the *Earth* afterwards is advanced to c ; and *Jupiter* to the part of his Orb 3, *Jupiter* will be seen advanced from B to C , alway keeping a Di-

rect motion. And when afterwards the *Earth* is come to d , and *Jupiter* to 4, *Jupiter* will appear to have advanced by a direct motion from C to D . And when the *Earth* hath reached the Point e , and *Jupiter* 5, then *Jupiter* will appear to have moved from D to E , according to the order of the Signs.

But when the *Earth* begins to be more directly interposed between *Jupiter* and the *Sun*, by that time the *Earth* comes to f , and *Jupiter* to 6, then will *Jupiter* appear to have gone back from E to F ; and because this interval is very small, therefore he is said to be *Stationary*, because he appears unmoved and standing still. The *Earth* afterwards being advanced to the point g , and *Jupiter* to 7, *Jupiter* will appear to have moved Retrograde from F to G . Again when the *Earth* is come to h , and *Jupiter* to 8, he will appear to have past Retrograde from G to H . And lastly, when the *Earth* is come to i , and *Jupiter* to 9, he will seem to have moved Retrograde from H to I , which space being very small, *Jupiter* will again appear *Stationary*.

Afterwards, when the *Earth* is advanced to k , and *Jupiter* to 10, he will seem to have proceeded directly, according to the Order of the Signs, from I to K . The *Earth* being come to l , and *Jupiter* to 11, he will seem to have pursued his Course directly from K to L . And lastly, when the *Earth* hath reached the Point m , and *Jupiter* 12, *Jupiter* will appear to have advanced directly from L to M .

The same may be demonstrated, not only concerning *Saturn* and *Mars*, but also concerning *Venus* and *Mercury*; which always appear *Stationary*, as oft as we remove from the opposite Region to the same; or from the same to the opposite Region; because the *Earth* is then so turned about, as to make them to be seen under the same fixt Stars, for some time together. These Planets appear *Retrograde*, when they are in opposition to the *Sun*, *Direct* when in *Conjunction*, and never so in any other places. But we are to observe, that *Retrogradations* are more frequently seen in *Saturn* than in *Jupiter*, and in him more frequent than in *Mars*, because of the slowness of *Saturn's* motion, which makes that the *Earth* in a shorter time doth overtake him. But on the other hand they are more rare in *Mars*, his motion being swifter than that of *Jupiter*, and consequently must spend more time to overtake him. But these Affections are not incident to the *Moon*, because she, in whatsoever part of the *Earth* we are, runs about us, as about her Center, her Orb being comprehended within the Orb which the *Earth* moves in.

CHAP. XX.

Of the Motion of the Moon, and its various Appearances, or Phases.

FORasmuch as it is manifest from what hath been already said, that the *Moon* is not only carried about the *Sun*, but also about the *Earth*, and that there is only a small space between us and her; we may easily guess her to be contain'd in the same Vortex with the *Earth*. And consequently since the matter of this Vortex, doth whirl the *Earth* about its Center from West to East, we may

XVIII.
How they come to appear Stationary and Retrograde

XIX.
How they come to appear direct again.

XX.
The same may be showed in like manner concerning Saturn, Mars, Mercury and Venus, but not of the Moon.

I.
The Moon is carried about in the same Vortex with the Earth.

may conclude that it also carries the *Moon* along with it. But since the *Circle* which the *Moon* runs through, is almost 60 times bigger than the *Compass* of the *Earth*, we may gather, that if the *Earth*, by its diurnal motion is whirled about its *Center* in the space of 24 *Hours*, the *Moon* will not be able to finish her *Revolution* in less than about a *Months* space.

This long time the *Moon* spends in her *Revolution*, is the Cause that she seems to run round the *Earth* every Day from *East* to *West*, whilst in the mean time the *Earth* turns round from *West* to *East*. Tho' this doth not hinder the *Moon* from appearing to run through all the *Signs* of our *Zodiack* from *West* to *East*.

The *Moon* is sometimes nearer to the *Earth*, and that is her *Perigæum*; and at other times further from it, which is her *Apogæum*. This comes to pass, either because the *Peculiar Vortex* of the *Earth* A B C D, is sometimes bigger, by reason of the *Matter* of the *First Heaven* more abundantly crowding into it; and at other times becomes less, because of the *Expulsion* of it again. Or else, because the *Moon* is more or less pushed on towards the *Earth*, by the various agitation of the *First Heaven*.

The *Moon* seems to move swifter when *New* and *Full*, than at the *Quarters*. The Reason whereof is, for that her *Vortex* A B C D, by being pressed upon by the *Orbs* of *Venus* and *Mars*, between which it is placed, is thereby reduced to an *Elliptical* or *Oval Figure*. Hence it is that the *Celestial Matter* moves more swiftly in the narrow Parts B and D, of this *Elliptical Heaven*, and more slowly in the broader Spaces A and C; and therefore the *Moon*, in her *Conjunction* and *Opposition*, or at the *New* and *Full*, must be more swiftly carried about the *Earth* towards the *East*; because the Spaces it then runs through are more narrow, and do not suffer it to wander.

If the whirling about of the small *Vortex* A B C D, which carries the *Moon* along with it, did only accord with the *Motion* of the *Earth*, then the *Moon* would appear to move under the *Equator* from *West* to *East*; and on the contrary, if the motion of the said *Matter* should only agree with the motion of that great *Vortex*, which has the *Sun* for its *Center*, then it would only be seen under the *Ecliptick*. But seeing it is to agree with the motion of them both, it follows, that its motion must neither be under the *Equator*, nor under the *Ecliptick*, but under another *Third Circle*, which comes nearer to the *Equator*, than the *Ecliptick*; because the *Moon* is nearer to the *Matter* of the *Sun's Vortex*, than to that of the *Earth*.

The *Moon* being a *Round Body*, and receiving its *Light* from the *Sun*, it follows, that always one half of it, yea, somewhat more, must be enlightened by him. For seeing that the *Sun* exceeds the *Moon* in *Bigness*, and that the bigger *Sphere* always enlightens above half of a less, it does follow, that above one half of the *Body* of the *Moon* must always be illuminated. But seeing that the *Moon* alters her *Position*, and in running about the *Earth* doth variously face the *Sun*; it must needs be, that according to its various Access to, or Recess of the *Sun*, less or more of the illuminated Half will appear to us; which Variations of

her *Appearance*, are commonly called her *Phases*.

The *Philosophers* commonly reckon up four *Phases* of the *Moon*, according to the *Fourfold* respect which the *Moon* hath to the *Sun*, in different parts of the *Zodiack*. Whence it receives different Names; for the *Moon's* meeting with the *Sun* in the same Degree of the *Zodiack*, is called the *Conjunction* or *New Moon*. Tho' it seems that the *Moons Conjunction* with the *Sun*, ought not to be accounted amongst her *Phases*; because the *Moon* at that time doth not appear to us at all, its enlightened part being wholly turn'd away from us, and its dark part turn'd towards us.

The first *Phase* therefore of the *Moon* is, when she being newly come from her *Conjunction* with the *Sun*, by moving in her *Orb* A B C D E F G H, reacheth B, whence she appears to us on the *Earth* I, *Horned* (or *Crescent-wise*) because of the *Hollowness* which is seen in her *Illuminated* part.

The second *Phase* is, when the *Moon* about the *Seventh* or *Eighth day*, being 90 Degrees distant from the *Sun*, doth represent the full Half of her *Enlightened* part C, whose *Horns* or *Points* are directed to that part of *Heaven* which is opposite to the *Sun*, as from whence it receives its *Light*. and here she appears *Bisected*, or divided into two *Halves*.

The third *Phase* is, when the *Moon* D, advancing towards an *Opposition* with the *Sun*, exhibits to us more than one half of her *Illuminated* part, and therefore appears *Gibbous* or *Bunching out* on both sides.

The fourth *Phase* happens, when the *Moon* E, being 180 Degrees distant from the *Sun*, and in *Opposition* to him, turns her whole *Enlightened* side towards us, who are placed betwixt the *Sun* and her.

The same *Phases* also belong to the *Moon* in *Decrease*, according to her various Aspects to the *Sun*. For when by going back she hath reach'd F, she appears *Gibbous*; when to G, *Half*; and at H, *Crescent-wise* again; till returning to A, her *Enlightened* part be wholly turn'd away from us towards the *Sun*.

The *Moon* is never less *Enlightened* than when she is at the *Full*, or in *Opposition* with the *Sun*; and never more than at the *New*, or when she is in *Conjunction* with the *Sun*; because when she is *Full*, only that part towards us is *Enlightened*: Whereas when *New*, she is wholly *illuminated*, that part which is then towards us being *Enlightened* by the *Earth*, and the other part that is turn'd from us, by the *Sun*. For the *Moon* doth not only borrow her *Light* from the *Sun*, but receives also some weak *illustration* from the *Earth*: Because the *Earth* being an *Opake Body*, must of necessity reflect part of her received *Light*; and forasmuch as the *Earth* is bigger than the *Moon*, consequently more *Light* must be deriv'd from the *Earth* to the *Moon*, than from the *Moon* to the *Earth*. This is confirm'd by Experience, because this *Secondary Light*, as *GALILÆUS* calls it, after the first *Quarter* quite vanisheth, by reason of the *Moon* being too far distant, and without those Bounds to which the reflected *Beams* from the *Earth* reach.

VII.
The Conjunction of the Moon with the Sun, is not to be accounted amongst her Phases.

VIII.
The first Phase of the Moon.
Figure 30.

IX.
The second Phase of the Moon.

X.
The third Phase of the Moon.

XI.
The fourth Phase.

XII.
The same Phases happen to the Moon, when she is in the Wane.

XIII.
The Moon is more illuminated at the New, than at the Full Moon.

X x

We

II.
The Moon may appear to move from West to East, or contrariwise, within the space of one Month.

III.
What the Perigæum and Apogæum of the Moon is.

Figure 29.

IV.
The Moon advances swifter when she is New, than in her Quarters.

V.
Why the Moon is not exactly moved under the Equator.

VI.
Above one half of the Moon is always illustrated by the Sun.

XIV.
The Moon
is some-
times En-
lightened
from the
Earth.

We know likewise by Experience, that this Light is more perceptible when the Moon is Eastward from us, than when she is West. The Reason whereof is, because in the former situation, the Light is reflected to her from all the Continent of Asia, and part of Africa, which are more proper to reflect the Sun beams, than those Seas which are towards the West. So that as the Moon doth at some times Enlighten the Earth; so at other times again, the Earth Enlightens the Moon.

XV.
What a
Periodical
and Syno-
dical Lu-
nar Month
is.

The Moon performs her Revolution in 27 Days and about 8 Hours; and this time is called the Periodical Lunar Month: And the time that intervenes betwixt the Conjunction of this Planet with the Sun, till the next Conjunction, is called the Synodical Month; which consists of 29 Days, and about 12 Hours. Wherefore, when on a certain Day there is a Conjunction between the Moon and the Sun, the Moon indeed will return to the same Degree of the Zodiac, at the end of 27 Days and near 8 Hours; but she will not meet with the Sun there, who by this time will be advanced 27 Degrees further to the East; so that the Moon will be fain to proceed two Days longer before she can overtake him.

CHAP. XXI.

Of the Eclipses of the Sun and Moon.

I.
What an
Eclipse of
the Sun is.

Forasmuch as the Earth by its Annual Motion, turns round about the Sun; and the Moon by her Monthly Revolution, is whirl'd about the Earth, it cannot be but that the Earth, Sun and Moon must sometimes meet, and be oppos'd to one another. Whence, if it so happens, that by the Moons intervening betwixt the Sun and the Earth, the Sun becomes obscured by her shadow, this we call an Eclipse of the Sun, because its Light is hindred from being diffused on the Earth. So that the Eclipse of the Sun, is nothing else, but a Failing of Light in some Region of the World, caused by the Diametrical Interposition of the Moon betwixt the Sun and that Country. Wherefore this Eclipse always happens at the Time of the Moons Conjunction with the Sun.

II.
What an
Eclipse of
the Moon
is.

But if the Moon come within the verge of the Earths shadow, and by this means be deprived of the Light it borrows of the Sun, this we call an Eclipse of the Moon. And accordingly, an Eclipse of the Moon is a Failure of Light in the Moon, because of the Diametrical Interposition of the Earth between the Sun and the Moon. For then is the Moon obscured by the shadow of the Earth, and it happens always at the Full Moon, or Opposition: Tho' this Observation be not perceiv'd by all the Inhabitants of the Earth; but by those only that are in that part of the Earth, which is Diametrically interpos'd between the Sun and Moon.

III.
An Eclipse
of the
Moon is
either Total
or Partial.

An Eclipse of the Moon is either Total, or Partial. A Total Eclipse is, when the whole Round of the Moon is cover'd with the Shadow of the Earth: Whereas in a Partial, a part of it only is obscured.

IV.
A Solar
Eclipse may

Betwixt these two Eclipses we are to observe this considerable difference, that the Failure of Light

in the Moon, is caused by the Interposition of the Earth, which really keeps off the Sun's Rays from it, hindring it from receiving its wonted splendour. But no such Defect of Light ever happens to the Body of the Sun, whose Light cannot be the least impair'd, because of the Moons Interposition between him and the Earth. And therefore an Eclipse of the Sun, may with more propriety of Speech be called an Eclipse of the Earth, the Defect of Light being only in Appearance in the Sun, but really and indeed in the Earth, which is then deprived in a greater or less degree of his Light.

We are to observe that, as the way of the Sun, or the Ecliptick, doth obliquely intersect the Equator in the two opposite Equinoctial Points; so likewise the Orb of the Moon is not directly under the Ecliptick, but cuts the same in two opposite Points at Oblique Angles; and these Points are called the Nodes, or the Dragons Head and Tail. For the clearer conceiving whereof we are to note, that the Ecliptick divides the World into two Parts, whereof that which contains the Northern Pole, is called the Northern part; as that which contains the opposite Pole, the South part. This supposed, we say that the Dragons Head is one of the Common Sections of the Ecliptick, as well as of the Circle which the Moon describes, when she passeth from the South part of the World to the North; and the other Section, by which the Moon passeth from the North to the South part of the World, is the Tail of the Dragon. The Orb of the Moon therefore, A B C D, doth not concur with the Sun's Ecliptick A E C F, but intersects the same in two places, at A and C. In or very near which Intersections the Sun and Moon must be, or else no Eclipse can happen. For beyond the Ecliptical Terms G H I K, there are no Eclipses; because every where else the Moon is either too high towards the North B, or too much depress'd towards the South D; so that where there is not a Conjunction, or an Opposition of these three Bodies, the Sun, Moon, and the Earth, at the New or Full of the Moon, neither Solar nor Lunar Eclipse can ever happen.

Wherefore we see, that the Eclipse of the Sun can only happen at the New Moon, when the Sun and Moon are in Conjunction. For since the Orb of the Moon only intersects the Ecliptick at two Points or Nodes, she must of necessity be found in one of these before she can cause an Eclipse. And forasmuch as the Sun meets twice only in a Year with the Moon, in or at those Nodes, the Sun cannot suffer an Eclipse more frequently, than about every sixth Month. The Moons motion also from West to East, being not always exactly under the Ecliptick, but deviating something from it towards the North or South, and consequently not moving directly between the Sun and us, it is apparent that no Eclipse can be, but when the Sun and Moon are together in the Dragons Head or Tail, which, as I said, happens but every sixth Month.

Accordingly the Eclipse of the Moon happens, when the Earth a, being directly interpos'd between the Moon b or d, and the Sun c, doth by its Conical shadow I h i, hinder the direct Rays of the Sun from reaching any part of the Body of the Moon, as in b and d, or only from illuminating some part

more pro-
perly be
called an
Eclipse of
the Earth.

V.
What the
Head and
Tail of the
Dragon is.

Figure
31.

VI.
The Eclipse
of the Sun
ever hap-
pens at the
New of the
Moon.

VII.
The Eclipse
of the
Moon hap-
pens only
at the Full,
tho' not at
every Full
Moon.

Figure
32.

part of it, as in *e* and *f*. The *Eclipses* of the *Moon* are only at the *Full Moon*, that is, whilst the *Sun* and the *Moon* are diametrically oppos'd in the *Dragons Head* and *Tail*; because then the *Earth* comes between them, and by its *Shadow* does obscure the *Moon*. Yet it doth not follow from hence, that there must be *Lunar Eclipses* every *Full Moon*; because the *Moon* having some *Latitude*, she is often at the time of her *Opposition* to the *Sun*, at a considerable distance from the *Nodes*, whence it happens that the *Shadow* of the *Earth* does not touch her; there being no possibility of an *Eclipse*, except the *Sun* and *Moon* be in the *Head* and *Tail* of the *Dragon*. And forasmuch as the *Sun* cannot be there above twice in a Year, it is evident, that we cannot have a *Lunar Eclipse* every *Full Moon*.

VIII.
The Cause
of a Total
and Partial
Eclipse.

A *Total*, or *Partial Eclipse* is caused, when the *Luminaries* are in *Opposition*, as in the *Lunar*; or in *Conjunction*, as in the *Solar Eclipse*, in or near the *Nodes*, or else at a little distance from them: For seeing that the *Axis* of the *Earth's Shadow* is always in the *Plain* of the *Ecliptick*, it cannot be otherwise, but that when this *Axis* coincides with the *Nodes*, the *Moon* passing that way, or near to it, must be wholly dipp'd in the *Shadow* of the *Earth*; but when more remote, then the *Moon* must be only in part obscured, as entering only into the verge or brim of the *Shadow*. And so likewise in the same manner, because the *Axis* of the *Lunar Shadow*, the *Sun* being behind it, doth then appear, when the *Moon* is in the *Ecliptick* or *Node*: Therefore it is necessary, that at that time when it doth not appear less than the *Sun*, it must cover the whole *Sun*, which otherwise covers only some part of it; viz. when the *Axis* of that *Shadow* being somewhat turn'd aside from our *Sight*, a part of the *Moon* only comes between us and the *Sun*.

IX.
A Total
Eclipse of
the Sun
happens
very rare-
ly, and
when it
does, lasts
only for a
Moment.

A *Total Eclipse* of the *Sun* is a thing seldom seen; for the *Moon* being much less than the *Earth*, cannot but rarely be so conjoin'd with the *Sun*, as to cover its whole Round, and hinder the *Light* proceeding from it to reach the *Earth*; but only so, as to cover some part of it with its *Shadow*. Besides, forasmuch as the *motion* of the *Sun* from *West* to *East* is very swift, she makes haste away from under the *Sun*, and therefore can only obscure it for a very short time. So that tho' we should suppose the *Moon* to be so conjoin'd with the *Sun*, that his *Light* might appear to be totally intercepted; yet could not the *Failure of Light* last above a *Moment*, seeing that in the next following *Moment*, some of its *Light* would be diffused from that part of the *Sun's Body*, which by that time would be got out of the *Shadow*.

X.
Eclipses
appear va-
rious in
various
Parts of
the Earth.

Thus it often happens, that tho' a *Total Eclipse* be perceived in some part of the *Earth*, yet in other parts the same is only *Partial*, and in other again *none at all*. This will clearly appear in the *Scheme* or *Figure*, where the *Moon a*, being interpos'd between the *Sun b*, and the *Earth c*; it is manifest that the *Inhabitants* at the *Point d* will be deprived of the whole aspect of the *Sun*, because of the interposition of the *Moon*; they who dwell at the *Point e*, will be depriv'd of the one half of it; whereas no part of the *Sun* will be obscur'd to them who live at *f*; and the same is to be understood of all other the *Inhabitants* of the *Earth*,

from whom the *Moon* turns away the *Sun-beams* more or less, according to their several situations.

This acquaints us with the Reason, why a *Lunar Eclipse* is perceiv'd in one and the same manner, by all those that are in the same *Hemisphere*, and have the *Moon* above their *Horizon*; but not the *Eclipse* of the *Sun*, which appears to some *Total*, to others *Partial*, and to others again *None at all*.

For the *Moon* being destitute of all *Light* of her own, must needs be perceiv'd alike obscur'd by all: Whereas the *Sun*, being *Lucid* of it self, cannot appear destitute of all *Light*, but only so far as it is cover'd by the *Globe* of the *Moon*, which intervenes between the *Sun* and the *Earth*; and forasmuch as the *Lunar Globe* is less than the *Sun*, or the *Earth*, it can no otherwise happen, but that some part of the *Earth*, to which the *Moon* appears equal to the *Sun*, or greater, must be depriv'd of the whole *Light* of it; whereas others, to whom it appears otherwise, are but deprived of the *Half*, or of more or less of its *Light*, and others again enjoy the whole *Light* of it.

The *Solar Eclipses* are not so frequent as the *Lunar*; for the *Body* of the *Moon*, which deprives us of the *Sun-beams*, being much less than the *Earth*, which deprives the *Moon* of *Light*, it cannot be otherwise, but that the *Moon* must more frequently meet with the *shadow* of the *Earth*, than our *Sight* meets with the *shadow* of the *Moon*. But this is not to be understood of the whole Round of the *Earth*, but only with respect to some determinate *Part* of it, as by *Example*, that place where we live: For otherwise there is no question, that every six Months *Solar Eclipses* happen in this or the other part of the *Earth*, and no less frequent than the *Lunar Eclipses*.

The *Duration of Eclipses* is not always the same. If it be enquir'd, what the greatest *Duration* of a *Solar Eclipse* is; *GASSENDUS* in his *Astronomical Institution*, determines it to be the Space of about 2 *Hours*. For seeing that the *Moon* spends a whole *Hour* from the time that she hath made a beginning of the *Eclipse*, by touching the *Western* brim of the *Sun*, with her *Eastern*, until the time that the same brim come to the *Eastern* part of the *Sun*, and thereby make the midst of the *Eclipse*; and because then only the *Western* brim of the *Moon*, is advanced to the *Western* brim of the *Sun*, which soon after it quits wholly: So that as soon as the *Incidence* ceaseth, the *Emersion* begins; it necessarily follows, that she must spend another *Hour*, before the same brim can reach the *Oriental* part of the *Sun* again, and wholly quitting it, put an end to the *Eclipse*.

The *Superiour Planets* suffer no *Eclipses*, when the *Earth* comes between them and the *Sun*; because the *Conical shadow* of the *Earth* cannot reach them. Yet those *Planets* that have any *Assitant Stars*, are subject to *Eclipses* by their *Interposition*, as is evident from *Observations* about *Jupiter* and *Saturn*.

XI.
Why the
Eclipse of
the Sun
never ap-
pears Total
to all the
Inhabit-
ants of
the Earth.XII.
Eclipses of
the Sun
are less
frequent,
than those
of the
Moon.XIII.
This last
time the
great
Eclipse of
the Sun
lasted.XIV.
Why the
Superiour
Planets
are not
subject to be
Eclipsed.

C H A P. XXII.

Of the Fixed Stars.

I.
What the
Fixed Stars
are.

THE Fixed Stars are so called, not because they rest without any motion at all, or because they are fastned to the Heaven, as so many Nails; but because, being seated in the Center of their several Vortexes, they always keep the same situation and distance from one another. So that the Fixed Stars are Lucid Bodies, consisting of the matter of the First Element flowing to the Center of the Vortex, and succeeding in the room of the Globuli that recede from thence, giving forth light from themselves, and much differing in Magnitude from each other.

II.
The Fixed
Stars are
higher than
the Planets

Tho' there seem to be an immense distance between us and the Planets, yet is the space that reacheth from the Earth to the Fixed Stars, much greater, because the Planets do sometimes hide the Fixed Stars, which they could not do, if they were not interpos'd between us and them, and consequently lower than the Fixed Stars. Moreover, forasmuch as the Astronomers have not as yet found out any thing, whereby to measure this vast distance, we may suppose it to be as great as we please.

III.
How the
Astronomers
find out that the
Fixed Stars
are higher
than the
Planets.

That the Fixed Stars are higher than the Planets, the Astronomers prove from the Parallax or Commutation of our Sight. They conceive two lines, the one drawn from the Center of the Earth, the other from its Surface, or from the Eye of the Spectator, through the Center of a Planet, and reaching to the Firmament beyond it. That which is drawn from the Center of the Earth, will be highest; whereas that which is drawn from the Eye of the Beholder is lower and more depressed, unless when they both end in the same Vertical Point. And forasmuch as the Point, in which the First Line is terminated, is accounted to be the true place of the Planet, and the Point in which the other line ends, the Apparent or seen place of the Planet, it is easily apprehended, what the Parallax is, viz. the difference or distance that is found betwixt both these places. Forasmuch therefore as there is no Planet that hath not some Parallax, the Astronomers infer, that the Region of the Fixed Stars is at a greater distance from the Earth than any of the Planets. For there would be no Parallax or change of the Sight, in case any Planet were as far from the Earth, as the Fixed Stars.

IV.
The Sun is
the greatest
of all the
Fixed Stars
as to our
sight.

The Sun is the greatest of all the Fixed Stars as to us, for that by reason of his nearness to us, he doth more strongly move the Luminous matter; for there is no question, but that if the Sun were beheld from the Fixed Stars, it would not appear any greater than they do. Yea, GALILEUS gathers that the Fixed Stars themselves, have greater appearing Diameters, their immense distance considered, than agrees with the common Astronomical Calculations, because if we take away their Beams, the Diameters of the Fixed Stars by this means become much less.

V.
Some Fixed
Stars are
higher than
others.

All the Fixed Stars are not placed in the Circumference of one Sphere, as some have imagined, by giving too much credit to their Senses; but as the Sun hath a space about it, in which no Fixed Star is contained; so likewise every Fixed Star must be supposed to be at a vast distance from any other,

and some of them at far greater distance from us and the Sun, than others of them. So that the inequality which is discerned to be betwixt the Fixed Stars, will be as much from their greater or less distance, as from the greater or less Bulk of their Bodies. And tho' the Region wherein the Fixed Stars are, appear Spherical to our Eye, yet would it be irrational to undertake to determine any thing concerning the figure of any Body, whose outward and inward Surface cannot be discovered by us.

For it is notorious, that Bodies of equal bigness, by reason of their unequal distances, appear to be unequal. Now to suppose all the Fixed Stars to be in one Plane, is not so much as probable, neither is there any reason to prove it: for tho' they be at vast distances from one another (which we boldly do assert) yet will they seem to be in one and the same Plain, after the same manner as Planets, Fixed Stars and Clouds seem to be in the same Plain, yea, and to touch the very Horizon, because there is nothing interposed between them, and our sight, whereby we may judge of their distance: And I durst lay it down for a general Rule, that all distance vanisheth, where we have no Sense nor Judgment of the intervening Bodies.

The Fixed Stars have a light of their own, as we have shewed in the foregoing part of this Discourse, that the Sun hath, whom we take to be one of the Fixed Stars; there being no other Lucid Body whence he might borrow his Light, in case he had it not in himself. And the same is evident also concerning the rest of the Fixed Stars, from the briskness of their Beams, and their vast distance both from us, and from the Body of the Sun, so that they cannot borrow any part of his Light. For we frequently perceive the Body of the Sun, covered with Spots, which like so many Clouds cover his Face, and by resting the Pressure of the Light, suffer only some languid Beams to proceed from him to us; and this, as Historians tell us, hath sometimes continued for a whole year together, and hath made the Sun all that while to appear with a pale whitish Light, like that of the Moon: And yet the Fixed Stars, during this time, were never found to have lost any thing of their Light; which must have followed in case they had received their Light from the Sun.

Again, that the Fixed Stars are of a fiery Nature, and like the Sun, shine with their own Light, may be thus proved; because if the Sun should be viewed from the Fixed Stars, it would appear no greater than one of the least of them; and therefore if the Sun were removed from us, as far as they are, its bulk would appear so much lessened, as scarcely to be conspicuous. And again, if we should suppose the Dog-Star, to be placed where the Sun now is, it would appear as great and glorious as the Sun now appears to us. Now this vast distance of the Sun from the Fixed Stars, sufficiently proves that it is impossible they should borrow their Light from him. Wherefore we must conclude, that the Light of the Fixed Stars, doth not at all differ in nature from that of the Sun, as consisting only, on their part, in the swift agitation of the matter of the First Element; and with respect to the Medium, in the motion they communicate to the Globuli of the Second Element, intervening between those Stars and us.

VI.
Why the
Fixed Stars
appear to
be in the
same plain.

VII.
The Fixed
Stars shine
with a
Light of
their own.

VIII.
The Fixed
Stars are
at too great
a distance
from the
Sun to re-
ceive any
Light from
him.

All

IX.
Why the
Fixt Stars
twinkle.

All the *Fixt Stars* do seem to *Twinkle*, the reason whereof is the strength and briskness of their *Rays*, whereby they strike upon our *Eyes*. Which appears from hence, that when we look upon them through a *Telescope*, their *Twinkling* is much diminished, the strength of their *Rays* being much weakned, by passing through the small holes thereof. Another cause of their *Twinkling* is, because their *Vortexes*, which on every side encompass our *Heaven*, are not perfectly round, but have irregular *Surfaces*, as may be seen in *Figure 20*: whereby it happens, that whirling about their *Centers*, and acting upon our *Heaven*, the *Rays* of the *Stars* come to fall obliquely upon it, and by that means are refracted; from which *Refraction* their *Scintillation* or *Twinkling* follows. The said *Scintillation* may also be caused by the agitation of *Vapours* and *Exhalations* in the *Air*; as we see little *Pebbles* that lie without any motion at the bottom of a *River*, do seem to shake, by reason of the continual flowing of the *Water*.

X.
How it
comes to
pass that
the Stars
do not ap-
pear in
their own
places.

For the same reason also it is that the *Fixt Stars*, are not seen by us in the same places, wherein they are indeed, but as if they were placed in the surface of our *Great Vortex*, which hath the *Sun* for its *Center*. And here they cannot appear in their own places, because the *Surfaces* are in a manner, never so disposed, that the *Rays* which pass through them, from these *Stars* to the *Earth*, do meet with them at *Right Angles*; for when they meet with them obliquely, it is necessary, according to the *Rules of Refraction*, that they must bend a little, because they pass more easily, by one of the sides of these *surfaces*, than by the other.

XI.
The Fixt
Stars seem
to move.

Tho' the *fixt Stars* are contained in their *Vortexes*, and always keep the same distance from one another, yet they seem to move, not only by a *Diurnal motion*, by reason of the *Earths Revolution* about its own *Center*; but also by another motion, according to which every *Star* seems to encrease its *Longitude*; ever since that time, when *HIPPARCHUS* 130 years before *Christ*, observed that the *Fixt Stars* had a motion like the *Planets*, from *West* to *East*; having taken occasion for making this Discovery from some observation of *TIMOCHARIS* and *ARISTILLUS*. For when *TIMOCHARIS*, amongst other *Stars*, had observed, that the *Spica Virginis*, was almost 8 degrees antecedently distant from the point of the *Autumnal Equinox*, He found the same *Star* to be only removed six degrees from the said point. From which observation he concluded, that they move by this motion about one degree, in the time of 100 years; and consequently that the *Fixt Stars* also had a motion of their own.

XII.
What the
cause is of
this ap-
pearing
motion.

In order to the Explication of this appearing motion of the *Fixt Stars*, we are to suppose, that the *Axis* of the *Diurnal motion* of the *Earth*, doth not accurately keep the same *Parallelism* in its *Annual Revolution* which it had before, but somewhat turns aside from the same, after the running out of a great many years; and tho' this *Deflexion* from the *Axis* of the *Ecliptick* be insensible; yet the *Earth*, by this *Reeling motion*, in the space of many thousand years, is the cause that its *Poles* describe a small *Circle* from the *East* to the *West*. And since that according to this

Hypothesis we conceive the *Equator of the Earth* to answer to different parts of the *Heaven*, it follows that the *Celestial Equator* must also change its place, and cut the *Ecliptick* at divers *Points*, from *East* to *West*. And because the *Longitude* of the *Fixt Stars* is computed from that time, in which these two *Circles* are intersected, it cannot be, but that the said *Longitude* must seem to be encreased every hundred years.

This will appear more manifestly, if we suppose that the *Declination* of the *Axis of the Earth* from the *Perpendicular* to the *Plane* of the *Ecliptick*, proceeds from the *Striate Matter* of the *First Element* (as shall be explained more at large in the sixth Part) which coming from that part of the *Second Heaven*, which is 23 degrees distant from the *Poles* of the *First Heaven*, and passing through its *Poles*, doth incline it to so many degrees. But because that part of the *Second Heaven*, which is fit and dispos'd, to drive the *Striate Matter* into the *Poles* of the *Earth*, and by this means to sway them obliquely, is insensibly turned round from 1 to 2, and from 5 to 6, and so on, according to the trace of the *Polar Circles* 1, 2, 3, 4, and 5, 6, 7, 8, which in this our age, are 23 degrees distant from the *Poles* of our *First Heaven* A C; whilst, in the mean time, the *Earth*, together with the rest of the *Planets* is moved in its *Annual motion*, according to the Succession of the *Signs* of the *Zodiack* from *Aries* ♈ to *Taurus* ♉, and from *Taurus* to *Gemini* ♊, and so on, by a contrary Motion to that of the *Second Heaven*, that communicates the *Striate Matter* to the *Earth*; by this means it comes to pass that the *Poles* of the *Earth* are by little and little turn'd about, respecting those *Polar Circles* at this time, with an inclination of 23 degrees, contrary to the course of their *Annual Motion*: So that the *Poles* of the *Earth*, which were directed to the parts of the *Polar Circles* marked N O, are now directed, to those parts of them that are marked L M.

Neither only is that part of the *Second Heaven*, which sends the *Striate Matter* to the *Poles* of the *Earth*, and directs or inclines them according to the trace of the *Polar Circles* 1, 2, 3, 4, and 5, 6, 7, 8, swayed about, but it is also lifted up to the *Poles* A C, of our *Heaven*, and is again by them, in that wrestling about, softly depressed. And this is the Cause, why the *Axis* of the *Poles* of the *Earth* I, doth now decline 23 degrees and 30 minutes, according to the magnitude, for Example, of the *Line* L M, or N O, from the *Poles* A C, of our *Heaven*, whereas formerly this *Declination* was of whole 24 degrees.

Wherefore altho' the change which happens to the *Longitude* of one *Star*, cannot but be like to that which happens to another; yet it is not necessary, that all the *Fixt Stars* together, should throughout all *Ages* obtain the same *Longitude*, since it is possible that this *Reeling* of the *Earth*, may be more sensible in this Age than in another. And therefore the Irregularity of the Apparent motion of the *Fixt Stars*, may be easily explained, by supposing, that the *Reeling* or *Titubation* of the *Earth* is not *Regular*; and that in some *Ages* it deflects somewhat more, and in others less.

We may likewise easily comprehend, that the apparent *Ecliptick*, must somewhat alter its *declination*, provided we conceive, that during this Ti-

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XIII.
Why the
Poles of the
Earth are
by little
and little
obliquely
turned the
contrary
way to its
Annual
motion.

Figure
34-

XIV.
The Longi-
tude of the
Fixt Stars
may be un-
equal.

XV.
How the
Change of
the Declina-
tion of
the Ecliptick
is made.

tubation of the Earth, its *Axis* inclines towards the plain of the *Ecliptick*, somewhat more at one time than another; for thus the *Equator* of the Earth, determines that of the *Heaven*, in parts that are at such different Distances from the *Ecliptick*. Now this *Reeling motion* of the Earth, follows necessarily from its being placed in the *Vortex* of the Sun: For it would be a great wonder, if being plac'd in the midst of a *Liquid matter*, as it is, it should continue there many Ages, without admitting any change in its situation.

XVI.
Why the
Fix'd Stars
are not
seen in the
Day time.

The *Fix'd Stars* are not seen by us in the day time, because the impression of the Sun's *Brightness* is so strong on our Eyes, that the *Light* of the *fix'd Stars* cannot make it self perceptible. The case is the same, as when our Ear being stunn'd with some great Noise, cannot perceive any low or weak sound: Or, as a *hot Hand* cannot distinguish the less sensible warmth that is in another Subject. Yet doth not this hinder, but that a Man plac'd at the bottom of a *Well*, may perceive the *Light* of the *fix'd Stars*; because there his Eye is not so strongly affected by the splendour of the Sun; neither doth any thing hinder a Star that is above the *Horizon*, from freely transmitting his *Rays*.

CHAP. XXIII

Of the Asterisms and Constellations.

I.
The Number
of the
fix'd Stars.

THO' the *Fix'd Stars* be dispers'd throughout the immense Space of *Heaven*, and can no more be numbred than the *Sand* on the *Sea-shoar*; yet the *Astronomers* have been pleas'd to determine a certain Number of them, which they have discover'd by the help of their *Telescopes*, as being nearer to us, and more in view. Of these they count 1022; which they have divided into 6 *Classes* or *Ranks*.

II.
The difference
of the Magni-
tude of
the Stars.

The greatest Stars of all are called, *Stars of the First Magnitude*; and of these there are 15.

The next to these are called, *Stars of the Second Magnitude*, of which there are 45.

After these follow those that are of the *Third Magnitude*, being 208 in number.

Of the *Fourth Magnitude*, there are 474.

The fifth *Class* of Stars, are those of the *Fifth Magnitude*; and of these there are 217.

The sixth *Rank* or *Order* of Stars contains 49, and are the least of all. To which, for the making up of the Number, 9 Stars called *Obscure*, are added, and 3 called *Misty* or *Cloudy*, because they can hardly be perceived.

III.
All the
Stars that
belong to
one of
these Or-
ders, are
not equal.

It is to be observ'd, that all the Stars that are of one *Class*, do not appear to us of the same Bigness and Brightness; but in every one of these *Divisions*, there are some that are Greater, some Less, and some of a Midling-size, between both. For the *Dog-Star* is the biggest of them all; and tho' the *Lyre* or *Harp* be of a very conspicuous Magnitude, yet can it not be compared with it; and the same may be said of the other *Orders* or *Divisions*. For the *Eye of the Bull* doth far exceed the *Lions-Heart*, and the *Virgins Ear of Corn*.

IV.
How the
Stars came
by their
several
Names.

To the end these Stars might be the better distinguish'd and remembered, the *Astronomers* have reduc'd them to certain *Constellations*, and affixed some *Signs* or *Figures* to them, according as they imagin'd them to have some resemblance or

agreement with such and such *Animals* or *things*.

The *Astronomers* reckon up 48 of these *Figures* or *Constellations*, whereof some are in the *Zodiack*, others without it in the Northern and Southern Hemisphere.

In the *Zodiack* are 12 *Constellations*: *Aries*, or the *Ram*, express'd by this Character V , as representing the *Head* and *Horns* of a *Ram*: *Taurus*, B , the *Bull*, the *Head* and *Horns* of an *Ox*: *Gemini*, or *Twins*, II , two *Bodies*, with their *Arms* and *Legs* twisted together: *Cancer*, the *Crab*, C , the *Claws* of a *Crab*, with their *Retrograde* going: *Leo*, the *Lion*, L , representing a *Lion's Tail*: *Virgo*, the *Virgin*, W , resembling a *Wing*, or the *folded Gown* of a *Damsel*: *Libra*, the *Balance*, B , the *Beam* of a pair of *Scales*: *Scorpius*, the *Scorpion*, M , the *Body* and *Tail* of a *Scorpion*: *Sagittarius*, the *Archer*, A , an *Arrow*, apply'd to a *Bow*: *Capricornus*, W , the *Head* and *Horns* of a *Goat*, with the *Tail* of a *Fish*: *Aquarius*, the *Waterman*, W , the pouring of *Water* out of a *Pitcher*: *Pisces*, the *Fishes*, X , two *Fishes* tied together with a *String*.

The *Astronomers* attribute to each *Sign* of the *Zodiack* 30 *Degrees*, tho' the *Asterisms* themselves be unequal, some of them being shorter, and others longer: For if 360 be divided by 12, the result will be 30.

In *ARIES* 3 Stars are most conspicuous, 2 in the *left Horn* of the *fourth Magnitude*, and 1 of the *third*, between the *Horns*; which *Tycho* calls the *Bright Star* in the top of the *Rams Head*.

The most considerable Star in the Sign *TAURUS* is placed in his *left Eye*, being a Star of the *first Magnitude*, and is therefore called the *Bulls Eye*. Near to it are other 5 Stars, which are called *Hyades*: And those 6, formerly 7 Stars, that appear on the *Back* of the *Bull*, are called *Pleiades* and *Vergilia*, in the midst of which is a Star of the *third Magnitude*, commonly called the *Bright Star* of the *Pleiades*.

There are 2 Principal Stars in *GEMINI* of the *second Magnitude*, whereof that in the *North Head* of the *Twins*, is called *Castor*; as that in the South, *Pollux*. There is also another Star of the same *Magnitude* in the *right Foot* of *Pollux*, towards *Orion*. There is also one of the *fourth Magnitude*, called *Propus*, because it is placed near the *left Foot* of *Castor*.

In *CANCER*, scarce any Stars appear, besides one of the *third Magnitude*, near to the *right Claw*, and 3 others of the *fourth*, 2 whereof are most noted, whereof 1 stands towards the North, the other towards the South.

The *LION* is adorned with divers *bright Stars*, 2 whereof are of the *first Magnitude*. That which is seen in his *Breast*, is called the *Lions Heart*, or *Regulus*; and that in his *Tail*, the *Lions Tail*. Besides these there are 2 other, the one in his *Neck*, the other in the utmost part of his *Back*; to which, if the next Stars in his *Loyns* be added, they, together with those of the *Hearts* and the *Neck*, will represent the Figure of a long *Square*.

In the *VIRGINS left Hand* is an *Ear of Corn*, in which there is a Star of the *first Magnitude*, commonly called, the *Virgins Ear of Corn*. There are also other Stars of the *third Magnitude*, dispers'd all along the *Virgins Body*.

SCOR-

V.
The Number
and Cha-
racter of
the Con-
stellations
in the
Zodiack.

VI.
Each Sign
contains
30 Degrees.

VII.
What are
the most
conspicuous
Stars in
every Sign,
and first in
Aries.
VIII.
What in
Taurus.

IX.
What Stars
are in
Gemini.

X.
What in
Cancer.

XI.
What in
Leo.

XII.
What in
Virgo.

XIII.
What Stars
are in the
Scorpion.

SCORPIUS, besides 2 Stars of the second Magnitude plac'd in the further part of his Claws, and 2 more of the third Magnitude in his Tail, hath another in the midst of his Body, called the Scorpion's Heart, plac'd between 2 Stars of the fourth Magnitude.

XIV.
What in
Libra.

LIBRA consists of 2 very bright Stars, which are called the Scales.

XV.
What in
Sagittarius.

In SAGITTARIUS are 4 Stars more considerable, which being plac'd on his Right Shoulder, constitute a Trapezium or Table; besides 3 or 4 that do somewhat resemble a Bow: Beyond the midst of which, there is another of the third Magnitude, which represents the form of an Arrow.

XVI.
What in
Capricorn.

The Chief Stars in CAPRICORN are 4 of the third Magnitude. There are 2 in his Tail that have a greater lustre than the rest; and two other in his Horns, the uppermost whereof hath a small Star joyned to it.

XVII.
What in
Aquarius.

In AQUARIUS, the most conspicuous Stars are some of the third Magnitude about his Shoulders, with 4 others about his right Hand; the one whereof is, as it were, plac'd in the midst of a Triangle, constituted by the other 3. And there is another in his right Hand of the third Magnitude; besides which there are many other of the fourth Magnitude, and more especially one at the end of the pouring forth of the Water, which is of the first Magnitude.

XVIII.
What in
Pisces.

The Constellation PISCES consists of many small Stars; there being but few amongst them that are as big as those of the fourth Magnitude: And tho' these Fishes are at some distance from each other, the one in the Neighbourhood of Aquarius, under the Neck of Pegasus, and the other near to the Ram or Aries, under the Breast of Andromeda; yet they are tied together with a kind of loose Riband, which is also adorn'd with several Stars of the first Magnitude.

XIX.
The Nor-
thern Con-
stellations,
without
the Zodiac.

The Constellations without the Zodiac, are either Northern or Southern. The Northern, which appear in our Hemisphere, are 21; the particular account whereof here follows, beginning with that Constellation which is next of all to the Pole.

1
The Little
Bear.

And this is URSA MINOR, the Lesser Bear; which consists of 7 Stars, 4 whereof represent a square Figure; whereof the uppermost in the Neck of the Bear, is of the second Magnitude; another lower than it, of the third; a third on the Back, of the fourth; and the last in the Back also, of the fifth. The hindmost and brightest of the other 3, is called the Pole-Star, because it is nearer to the Pole of any other.

2
The Great
Bear.

URSA MAJOR, the Greater Bear, consists likewise of 7 Stars, whereof the 4 that represent a square, exhibit so many Wheels, and the other 3, the Beam of the Wain, and the Oxen or Horses that draw it; and therefore was called by the Ancients, *Plaustrum majus*, or the Greater Wain.

3
Bootes.

BOOTES, the Herdsman, or rather the Driver of the Oxen, called also *Arctophylax*, the Bearward, consists of many Stars of the third Magnitude, plac'd in the shoulder, back and knees of this Figure. But one of them is more famous than any of the rest, placed between his Thighs, on the rim or edging of his Coat, being of the first Magnitude, and is called *Arcturus*.

The DRAGON consists of many Stars, but none of them greater than those of the third Magnitude; only there are 2 in the Head of it, that are brighter than the rest.

The CROWN of ARIADNE, plac'd at the Right shoulder of Bootes, represents a half Circle, compos'd of 5 Stars; whereof 3 are of the fourth Magnitude, one of the fifth, and another of the second, which is called the Bright Star of the Crown.

ENGONASI, the Man, according to some Hercules, Kneeling, comprizeth several Stars all of the same Magnitude; of which one especially is more conspicuous in the Head of this Figure, for its being of an equal size, with another Star like it, found in the Head of Ophiuchus.

LYRA, the Harp, which by some is called the Failing Vulture, hath the most eminent Star of the first Magnitude, next to the Dog-Star; besides which it contains some few other Stars, 2 whereof are of the second Magnitude.

The SWAN is an illustrious Constellation within the Milky-Way, resembling the Form of a Cross; and hath a very notable Star of the second Magnitude.

CEPHEUS hath his Head pointing to the Swan, and his right Foot standing on the Tail of the Little Bear. It contains but few bright Stars, besides 3 of the third Magnitude, one in the Right shoulder, another in his Girdle, and a third in his Right knee.

CASSIOPEIA hath 5 Stars of the third Magnitude, over against the Great Bear, the least being in the midst of them; 3 of these are on the outside, one of them being called the Bright Star of the Chair; another upon her Breast, called Schedir, the third near her Flank; all which represent the Figure of a Triangle.

PERSEUS is plac'd between the Feet of Cassiopeia and the Bull, the most bright Star of which Asterism, that on the Back, is of the second Magnitude. It hath also another famous one of the third Magnitude, which being placed in the Head of Medusa in the Left hand of Perseus, is therefore called the Head of Medusa, and the other 4 are call'd Gorgons.

ANDROMEDA is an Asterism under Cassiopeia, on the Left-side of Perseus; very remarkable, because of 3 Stars it hath of the second Magnitude; one whereof is on the Left Foot, above the Triangle, the other in the Girdle, above the Fishes; the last in the Head, which is common to her and Pegasus.

DELTOTON, or the Triangle, consists of 3 Bright Stars of the fourth Magnitude, one whereof is at the top, and the other 2 at the Basis of it, with another Star of the fifth Magnitude, near to it.

AURIGA, the Wagoner or Wain-Driver, hath a Star of the second Magnitude in the Left Foot, where there is also another of the fourth Magnitude. But the most noted of them all is a Star of the first Magnitude very illustrious, on the Left shoulder, called Capra, the Goat.

PEGASUS, or the Flying-Horse, is a notable Constellation, by reason of a large square compos'd by 4 of its Stars of the second Magnitude. Besides which it contains other 3 of the third Magnitude, the one in the Knee, the other in the Neck,

4
The Dra-
gon.

5
The Crown
of Ariadne.

6
Engonasi.

7
Lyra, or
the Harp.

8
The Swan.

9
Cepheus.

10
Cassiopeia.

11
Perseus.

12
Andromeda.

13
Deltoton,
or the Tri-
angle.

14
Auriga.

15
Pegasus.

	Neck, and the third in the Opening of the Mouth, which is therefore call'd the Mouth of Pegasus.	HYDRA, the <i>Hydre</i> , a Water-Serpent, is a long extended Asterism; for with its Head it toucheth the Claws of the Crab, and its Tail is near to <i>Libra</i> , or the Ballance. It hath a very bright Star in its Breast of the first Magnitude, called the Heart of the Water-Snake.	8 Hydra.
16 The Dolphin.	The DOLPHIN, seen between the Constellation of the Colt and the Eagle, has 10 Stars, whereof 5 are of the fifth Magnitude: The other, except that which is in the Tail, do constitute the Figure of a Lozenge.	The BOWL, or Cup, is placed upon the Middle part of the Hydra, having some Stars of the fourth Magnitude, representing an half Round.	9 Crater, the Bowl.
17 The Arrow.	The ARROW hath 5 Stars, of which, that at the Point is of the fourth Magnitude.	The CROW is very remarkable, by reason of the Table in it, consisting of 4 Stars, whereof 3 are of the third Magnitude, and another of the fourth.	10 The Crow.
18 Equuleus, or the Colt.	The COLT is nothing else, but as it were the shadow of the Head of Pegasus, in which are seen 4 Stars, all of them of the fourth Magnitude.	The CENTAUR, besides 14 visible Stars, hath others that are not conspicuous to us; whereof 1 is of the first Magnitude, at the right Fore-foot of the Horse. In his hind Legs are 4 Stars, which represent a very remarkable Cross. The Uppermost and Lowermost are of the second Magnitude; but the Right and Left of the third.	11 The Centaur.
19 The Eagle.	The EAGLE is considerable for 3 Stars, representing the situation or position of Orions Girdle. The 2 that are at each end, are only of the third Magnitude; as likewise 2 others at the end of his Tail: The Star which is in the middle is of the second Magnitude, and out-shines the rest, being therefore call'd, the Bright Star of the Eagle.	The WOLF, or Wild-Beast, doth with his Head reach the middle part of the Scorpion; it hath no Stars bigger than of the fourth Magnitude.	12 The Wolf.
20 Serpentarius.	SERPENTARIUS OPHIUCHUS, or the Serpent-Bearer, is a great Asterism; for its Head is near to the Head of Hercules; its Feet rest upon the Scorpion; the Head of the Serpent reacheth to the Northern Crown, and its Tail to the Eagle. Its greatest Star is only of the third Magnitude. Yet there is one of these that is very considerable by the right Ham, between the Scorpion and Sagittary, which in the Fourth year of this Century was accounted amongst the Great Stars.	The ALTAR, or Censer, is for the most part hid from us under the bending of the Scorpions-Tail. It hath no greater Stars, than of the third Magnitude.	13 The Altar.
21 The Serpent of Ophiuchus.	The SERPENT of Ophiuchus, is famous for several Stars of the third and fourth Magnitude, in the middle Joynt of the Neck, next to that Hand in which Hercules holds his Club.	The SOUTH-CROWN hath one very notable amongst the rest, of the third Magnitude; and is the same which is called by some Uraniscus, or the Petty-Heaven.	14 The Southern-Crown.
XX. The Southern Constellations, without the Zodiac.	The Southern Signs are 15 in Number, without the Zodiac.	The SOUTH-FISH contains many Stars, and those of the fourth Magnitude, under the left Leg of Aquarius. In its Mouth it hath a Principal one of the first Magnitude, called Fornabant.	15 The South-Fish.
1 The Whale.	The first is the WHALE, situate under the Fishes and the Ram, having a vast wide Mouth, in the midst whereof is a Star of the first Magnitude, the Bright Star of the Jaw-bone of the Whale; and hath another of the same Magnitude answering to it, in the midst of the Point of his Tail; besides other Stars over his whole Body, of the third and fourth Magnitude.	Tho' the Constellations of the Zodiac, together with the North and South, are reduced to the Number of 48; yet we are to know that the Astronomers could not comprize them all into Figures, but were fain to leave some in the Intervals of them, which they called Unformed, as being comprehended in no Figure or Image.	XXI. What these Stars are that are Unformed.
2 The River Eridanus.	ERIDANUS is a long and winding Asterism betwixt Orion and the Whale. The end of which, towards the South, is invisible to us.	The Astronomers also make mention of the Galaxy, or Milky-way, which is nothing else but a vast multitude of thick-set Stars, that by their weak Light represent the appearance of Milk in a clear Sky, as the Telescope hath informed us. Whereby ARISTOTLE is convinc'd of a manifest Error, who suppos'd the Milky-Way to be a Meteor; who yet therein is to be pardoned, because he wanted the Helps that we have to discern it better.	XXII. What the Galaxy, or Milky-way, is.
3 The Hare.	The HARE, besides other of the Stars whereof it is composed, hath 4 of the first Magnitude, and other 4 smaller ones in his Ears.	We are to observe, that when that the Sun, or any Planet, is said to be in a Sign: As for Example, in the Ram, or in the Bull; the meaning thereof is, that it is plac'd under it, or that it intervenes, or is intercepted between our Eye and that Sign. For it is certain, that the Zodiac, and its Signs, are at a vast distance from the Planets. But this way of speaking hath obtain'd, because the Planets appear to us, as if they were in the Region of the fix'd Stars. For our unassisted Sight cannot discern which of the Stars are farther from, or nearer to us. Hence it is, that because we know that the Planets are nearer to us than the Stars, we understand them to	XXIII. How the Sun, or any Planet, is said to be in a Sign.
4 Orion.	ORION is a Constellation, adorned with many bright Stars. Of these, 2 principal ones are in his Shoulders, 3 in his Girdle, which are called Three Kings; 1 in his right Knee, and another in his left Foot, called Rigel.		
5 The Great Dog.	The GREAT DOG hath not his equal for Brightness, and is commonly call'd Sirius, as being supposed to Dry all things. About his right Feet he hath some Stars of the third Magnitude.		
6 The Little Dog.	The LITTLE DOG riseth before the Greater, and is, as it were, the Harbinger of his Rising. Besides the Star which is in his Neck, of the third Magnitude, he hath another Bright one in his Thigh of the second Magnitude, called Procyon.		
7 The Ship Argo.	The Ship ARGO hath but a few Stars that are conspicuous, except it be about the Mast. In its Helm is a very noted Star, called Canopus.		

to be so placed, as to be between us and the Signs. But the Stars that are without the Zodiac are said to be in that Constellation, or rather to belong to it, between which and the next Pole of the Zodiac they are placed.

CHAP. XXVI.

Of the Influence of the Stars, and of Judicial Astrology.

IT is a Question frequently handled by the gravest Authors, Whether the Stars act upon these Inferiour Bodies; and whether the Things that happen here on Earth do depend on their Influences. Or to speak more plainly, Whether the Stars be the Cause of those Effects we see in this Sublunary World; or at least, contribute something to their Production. For the better understanding of this Question, it will be necessary to examine the Virtue and Power of the Stars, and thence gather their manner and way of acting.

There is no doubt, but that the Sun concurs by a real influx to the Production of Terrestrial Bodies; yea, if we give heed to his Virtue, we shall find him to be the only, or at least the Principal Cause of all things that are generated in the Earth; for the Growing of Plants, the Nourishment of Trees, the Ripening of Fruit, and the Springing of Corn, are all to be refer'd to the Sun, by whose Heat they are cherished, grow, and are brought to perfection.

If you say, That many things happen in the Earth which cannot be imputed to the Sun; as Cold and Moisture, which require a Cause distinct from that of Heat. For how can Heat be conceiv'd to be the Original of Cold? Or, how can the Sun, who is of a fiery Nature, produce Moisture, since the Natural effect of Fire is to dry, and deprive a Body of all Moisture? And therefore the Sun can only be said to be the Cause of some particular Effects.

I Answer, It is true that Cold and Moisture do not proceed from the Sun, as their productive Cause; yet doth not this contradict their proceeding from the Sun accidentally. For as his presence drives away the Cold, and suffers it not to prevail on the Earth; so his absence suffers it to prevail, and exposeth Terrestrial Bodies to its constriction. In like manner, tho' Moisture doth not descend from the Sun; yet because the same abounds in the Earth, and that the Sun doth not always elevate the same into Vapours, therefore he may be said to be an Accidental Cause of it.

The Sun therefore is to be considered by us as a General or Universal Cause, which every where diffuseth its Beams; yet it happens by Accident, that he illuminates one part of the Earth more than another: As it is accidental to Fire, that this or the other thing comes near to it, to be heated and cherished by it, or not. And hence it is, that all that variety, which we see in Nature, doth not so much proceed from the Sun, as from the various situation and disposition of Bodies. For the reason why in one part of the Earth it is Spring, in another Autumn, in a third Summer, doth not proceed from the Sun as a Special Cause, but only as a General, the Sun being always the same, and equally diffusing his Heat. For that it is now, suppose,

Summer with us, by the Sun-beams falling more directly upon us; this is owing to that Part of the Earth wherein we live, whose situation is so directed towards the Sun, as to receive his Beams more directly, at the very same time that it is Winter with our Antipodes, to whom the Sun-beams are obliquely directed.

I know that some Philosophers refer the Cause of this diversity to the Planets, as supposing Saturn to be Cold; Mars, Hot; Venus, moderately Warming; Mercury, Various; the Moon, Cold and Moist. But these I take to be no more than meer Fictions, since we perceive no Cold from Saturn, nor Heat from Mars; and so from the other Planets: Because it cannot be, that we should feel or perceive any of these Qualities, but that at the same time all the other Inhabitants of the Earth must perceive the same, seeing that they are sensible of these Vicissitudes of Seasons, as well as of the Sun's Heat; and therefore these Changes depend on the various position of the Parts of the Earth. As we see, that the South-Winds, which produce Warm Weather in the midst of Winter; and North-Winds, which cause Cold in Summer, do not arise from the Aspects of the Planets, since the same Aspects are over the whole Earth, and yet we do not find the same Winds every where; so that they proceed only from the various disposition of the Regions of the Earth.

Neither do the Fix'd Stars seem to dispense any Influences to us here below, because their vast distance hinder them from producing any Effects here: For tho' by their Light they may put the subtil Matter contain'd in the Pores of the Air into motion, and by means thereof agitate other grosser Matter, which thereby may produce a sensible Effect; yet because we know of no other Virtue that is in them, whereby they might act upon these Inferiours, save only their Light, we cannot attribute to them any Effects, besides those that proceed from Light: And forasmuch as the Light of the Sun is incomparably greater than that of the Fix'd Stars, we are to attribute all Natural Effects to the Light of the Sun, as the General and Primary Cause of them.

This Opinion may be further confirmed, if we consider that the Fix'd Stars do not Rise and Set now at the same time as formerly; but because of their turning round from East to West, they Rise now almost a whole Month later than of Old: And yet the Seasons and General Changes that are in the World still observe the same Tenour, and correspond with the Sun's Course through the Zodiac. For the Dog-Days, by Example, or that great Heat, which in old Times was perceived about the midst of July, still continues about the same term, neither is changed to the midst of August, at which time the Dog-star, which they make the Cause of its Heat, doth now Rise. Neither can we suppose, that 6000 years hence, this Heat will be removed to the midst of November, at which time the Dog-star will then Rise. Besides, if the Heat we perceive in Summer be to be ascribed to the Dog-star, how comes it to pass that at the same time the said Star is almost 40 Degrees distant from the Sun? Since it might be rather expected it should display its Heat in the Winter, when it is conjoyn'd with the Sun, viz. about the 29th of October.

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The

VI.
The Planets contribute nothing to any sublunary Effects.

VII.
The Fix'd Stars send down no Influences upon these Inferiour things.

VIII.
The Fix'd Stars do not always Rise and Set at the same time; and yet we find that the General Changes of Seasons in the World keep the same time.

I.
The sense of the Question stated.

II.
The Sun influenceth this sublunary World.

III.
An Objection against the Virtue of the Sun.

IV.
Answer.

V.
The Sun is the General Cause of all Effects produced in the Earth.

IX.
The Cause
of the
great Heat
in Summer.

The Cause therefore of these great Heats is, because the *Sun* at that time sends down his *Beams* more perpendicularly upon us, and continues longer above our *Horizon*; and forasmuch as this perseveres for some Days after the *Solstice*, during which time new degrees of *Heat* are still added, it cannot be otherwise, but that the *Heat* during that time must be increased.

X.
The Moon
produces
no Effects
upon the
Earth.

Neither doth the *Moon*, tho' she be so near unto us, produce any Effects here below. I know that several Effects are attributed to her by some; as the Breaking or Splitting of *Stones*, and the increasing of *Oysters*, and other *shell-Fish*, at the Increase of the *Moon*, and their decreasing at the Wane of the *Moon*; as likewise that the *Bones* of *Animals*, at the Full-Moon, are full of *Marrow*, whereas at the New they are almost empty.

XI.
What is
the Cause
why Stones
are broken.

But all these Effects may be with more Truth attributed to other Causes, than to the *Moon*. For as to the breaking of *Stones*, the same may with more Reason be attributed to the *Sun*, than to the *Moon*; seeing it is certain, that some *Stones*, after many years lying expos'd to the *Sun*, have been calcined. And therefore seeing that the *Sun's* beams reach the *Stones*, as well as those of the *Moon*, it seems very reasonable that this Effect should rather be imputed to the stronger, than the weaker Agent.

XII.
The increase
or decrease
of Oysters,
doth not
proceed
from the
increase or
decrease of
the Moon.

So likewise it is a Popular Error to imagin, that *Oysters* and other *shell-Fish*, are bigger and fuller at some times of the *Moon*, than at others: For tho' they are sometimes bigger than at other times, yet is not this to be ascribed to the *Moon*, but rather to *Chance*, because they have not had sufficient *Food*, or because the tossing of the *Sea* hath forced them to some Evacuations. This is apparent in those *Fishes* which are taken in the same place, and in the same day: For those which are caught in a *Net*, and immediately taken out thence, are fuller Bodied and better Fed, than those which having been long kept up, have lost much of their *flesh* by striving to get out. The original therefore of this Error hath been, for that some have taken that to be caused by the *Moon*, which was merely fortuitous. And accordingly we find, that indifferently at any time some *Oysters* are found to be fat and full, and others lean and poor.

XIII.
The Cause
why more
or less
Marrow is
found in
the Bones
of Living
Creatures.

And the same may be said of the *Marrow* that is found in the *Bones* of *Animals*: For several who have examin'd the matter, have found that there is no more *Marrow* in the said *Bones*, at any one precise time, than at another; but that the want or defect thereof sometimes is caused, by want of *Food*, or for that the *Beasts* have been tired by long Journeys before they were kill'd.

XIV.
What Ju-
dicial
Astrology
is, and of
how many
kinds.

Astrology is an Art, which foretells future things from the motion of the *Heavenly Bodies*, and their Aspects to one another. And is therefore called *Judicial*, because from these it judgeth of the Events of things. *Astrology* is twofold; the one is that *Art*, which from the position of the *Stars* at the time of *Birth*, judgeth of the *Inclinations* and *Temper*s of *Men*, whether they will be *Passionate*, *Melancholy*, *Wise*, *Venerable*, &c. because the Hour of their *Nativity* was accompanied with such or such Aspects of the *Stars*, which have a

Virtue of causing the *Gall*, *Melancholy*, or *Spirits* to abound. The second kind of *Judicial Astrology* is that *Art*, which from observing of the *Horoscope*, judges of *Future Events*, *Children*, *Manner of Life*, *Marriage*, *Honours*, *Misfortunes*, *Losses*, &c.

This *Judicial Astrology* was first cultivated by the *Chaldean* and *Babylonian Philosophers*, who not only affirmed that they could Foretell *Future Events* from the Aspects of the *Stars*; but also boasted that by them they could discover the particular Actions of *Men*, and the special Events of their *Lives*. But that both the one and the other of these are vain and false we prove as follows:

First, Because the *Astrologers* had no exact knowledge of the *Virtues* of the *Stars*, no not of such as were most Notorious. Secondly, Because they were ignorant of the Nature of most *Stars*, which might variously alter or hinder the operations of those *Stars* they knew. Thirdly, Because no sufficient Reason can be given, why *Schemes* for *Nativities* are erected from the point of *Birth*, rather than from that of *Conception*. Fourthly, Because the *Astrologers* themselves own, that they have no Principles whereby they might be informed, that the *Stars* have such *Virtues* as they assign to them, and that consequently their *Predictions* are not any deductions from *Premises*, but the Dreams of Idle men.

Besides, how can they be assur'd of the certainty of the Events they pretend to guess at? Not by Experience: For who will conclude that it will lighten, for Example, upon the *Kings* entering into *St. James's Park*, because once it hapned so? Or that some *King* will dye at the Appearance of a *Comet*; because it hath been found, that upon the Appearing of a *Comet* some *Prince* hath died? And much the same Evidence the *Astrologers* have for their *Predictions*, since it is but once in many thousand years, that the *Stars* are found in the same position.

But let us grant the *Astrologers*, that some Changes have been observ'd to come to pass in certain places of the *Earth*, under such *Constellations*; yet can these only be of use to those *Countries* where they hapned: Seeing it is most certain, that the same *Fair weather*, or *Tempests*, do not happen to all parts of the *Earth* at the same time: For we see it *Rain* in one part, whilst it is *Fair weather* in another. And thus the *Dog-star*, which most suppose to be *Hot* by Nature, and to be the Cause of the greatest *Heat* when it riseth in *July*, is notwithstanding a sign of *Cold* to our *Antipodes*, and to those that live in the South-part of the *Earth*; because they at the same time that this *Constellation* riseth, together with the *Sun*, and we feel the greatest *Heat*, experience the greatest *Cold*: Notwithstanding that it is then directly over their *Heads*, and sends down its direct Rays upon their *Country*.

Conclude we therefore, according as we have said at the Beginning, that the *Sun* is the General Cause of all the Effects that happen in this *Sublunary World*, forasmuch as by his presence he is the Cause of *Heat*, and by his absence of *Cold*; and that all the rest of the *Stars* or *Planets*, cannot be the Cause of any Alterations in these *Sublunary things*.

XV.
Who were
the first
Professors
of it.

XVI.
Reasons
against
Judicial
Astrology.

XVII.
Astrologers
can have
no certain
Experience.

XVIII.
What hap-
pens to one
part of the
World, can
not be
brought as
an Argu-
ment to
prove that
the same
will hap-
pen in the
other parts.

XIX.
The Con-
clusion.

The



The Sixth Part
 OF THE
INSTITUTION
 OF
PHILOSOPHY.
 OF
The Four Great Bodies,
 Viz. THE
EARTH,
 THE
WATER,
 THE
AIR, and FIRE;
 AND OF
The Mixt and Compound Bodies, which arise from them ;
 AS ALSO OF
METALS, and METEORS.

CHAP. I.

Concerning the Original of the Earth, its Parts and Figure.

I.
What the
Earth is.

II.
The For-
mation of
the Hab-
itable Earth.

THE EARTH is a congested Mass of the greater Particles of the Third Element, having Irregular Figures, and by Rest clinging together.

But, forasmuch as by the Name of EARTH, we commonly understand the whole Globe which we Inhabit, it will be a fit place here to speak of its Original, and to describe how at first it might have been form'd, had it so pleas'd GOD: Let us imagine therefore, that it was made at first only of the Matter of the First Element, being like unto the Sun, tho' much less than it; and that it

had a vast and peculiar Vortex in the Center whereof it was seated. But that by the clinging together of the less Subtil Parts of the First Element, they were changed into the Matter of the Third Element, which gathering together produced dark Spots about its Surface, like to those that are continually generated about the Sun, and again dissolved. Upon the continual Dissolution whereof, the remaining Particles of the Third Element, being scatter'd through the Neighbouring Heaven, made there a vast Mass of Ether, which being afterwards greatly increased, caused the generation of more compact Spots, which at last wholly cover'd the whole Earth. Which Spots being no longer in a condition to be dissolved, and many of them lying heaped together, and the Force of the Vortex, which contain'd the Earth being thereby diminish'd,

gave

III.
There are
three Re-
gions to be
distinguish'd
in the
Earth.

Figure
35.

gave occasion to the *Sun's Vortex* to swallow up the *Earth*, together with the *Spots*, *Air*, and all, which stop'd in that place where it now is.

Supposing the *Earth* in this *State*, we are to take notice of *Three Regions* in it: Whereof the *First* and *Inmost* I seems to contain nothing but the *Matter* of the *First Element*, which is there moved like the *Sun*, and much of the same Nature; save only, that probably it is not so pure, because it cannot rid it self of that *Matter*, which the *Sun* continually casts forth, and of which *Spots* are generated. The *Middle Region* M, consists of a very dark and compact *Body*: For seeing that this *Body* was at first made up of very minute *Particles* (as at first appertaining to the first *Element*) joyn'd together, it seems probable that there could be no *Pores* in it, but such only as were so small, that they could only transmit those *striate Particles* with the other *Matter* of the *First Element*. And Experience witnesseth as much in the *Spots* of the *Sun*, which being of the same nature as this *Body* M; save only that they are much more thin and loose, do notwithstanding obstruct the passage of *Light*, which could not be in case their *Pores* were large enough to admit the *Globuli* of the *Second Element*. For seeing that these *Pores* were at first formed in fluid and soft *Matter*, they would also without doubt be strait and smooth enough, not to hinder the Action of *Light*. But these two *Regions* of the *Earth* do not much concern us, as being conceal'd from us. The *Third Region*, is that out of which all *Earthly Bodies* are formed, as we shall shew hereafter: At present we suppose nothing to be in it, besides a *vast Mass* or gathering together of the *Particles* of the *Third Element*, encompass'd with much *Heavenly matter*, whose nature we may easily understand from the manner of their *Primordial Generation*.

IV.
The Forma-
tion of the
various
Earthly
Bodies.

V.
The Upper-
most Region
of the
Earth dis-
tinguish'd
into two
Bodies.

Fig. 36.

VI.
The For-
mation of
the Third
Body, be-
tween the
two former

From what hath been said, we easily apprehend, that no great Change could happen in the innermost or middle *Region* of the *Earth*; but the *External part* of it, was capable of being formed into various *Bodies*. For at the first 2, then 3, and afterwards 4, with many other different *Bodies*, were to be made out of it.

And here, in the first place let us consider, that the grosser *Particles* of this *Third Region* being thrust down below the rest, by the force of the *Heavenly Globuli*, this *Supream part* of the *Earth*, here marked with the Letter A, is thereby distinguish'd into two different *Bodies*, represented by B and C; whereof the uppermost B, is of a loose contexture, fluid and pellucid; whereas the undermost is somewhat close, hard and opaque.

Again, because we find that the *Body C* was distinguish'd from the *Body B*, only by this means; because its *Parts* being prest downwards by the *Heavenly Globuli*, did cling together, we shall easily apprehend, that it was necessary that another *Body*, such as is that marked D, must have been generated between them. For the *Figures* of the *Particles* of the *Third Element*, of which the *Bodies* B and C consist, are very different, and may be here distinguish'd by us into 3 Chief General *Heads*; for some of them are variously divided and extended like the *Branches* of *Trees*, and these chiefly were those, which being driven down by the *Celestial matter* cling together, and compose

the *Body C*. Again, there are others that are more solid, and as to their *Figure*, are not all of them Round or Cubical, but of several *Figures*, like the small parts of *Rubbish*; and these, if they be somewhat great, sink down below the rest by the force of Gravity; but in case they be somewhat less, they continue mix'd with the former, and fill up the Spaces that are left by them. Lastly, there are some of a longish *Figure*, and without any Jettings-out like *Boughs*, but like long and even *Sticks*, which also mingle themselves with the former, where they find *Pores* or *Intervals* wide enough for them to enter, but do not readily cling or stick to them. Which being thus suppos'd, it will be obvious to believe, that when first the *Branchy Particles* of the *Body C* began to be entangled together, many of the *Longish* were intermix'd with them; and that they afterwards, whilst those being still more and more prest down, became more closely joyn'd together, got up above them towards D, and there constituted a *Body*, very different from the two other B and C. After the same manner as we see, that by Treading the *Earth*, in *Moorish places*, *Water* is squeez'd out of it, which afterwards comes to cover the *Surface* of it.

Now when some other *Particles* less solid than those of the *Body D*, fell down from B, they stuck to the surface of the *Body D*; and because most of them were *Branchy*, they by degrees clung together, and constituted the hard *Body E*, very different from B and D, which are fluid. Which *Body E*, at the first was very thin, like a *Crust* or *Shell* covering the *Body D*; but grew thicker in process of time, new *Particles* from the *Body B*, as likewise from D, joyning themselves to them.

We are likewise to consider, that it could so happen in process of Time, that a great part of the *Body D*, might be wasted, by which means a considerable Space F, might be left between D and E, which could not be fill'd up with any other matter, besides that out of which the *Body B* did consist, the thinnest *Particles* whereof, easily found a passage through the *Pores* of the *Body E*, into those places which were quitted by other thicker parts, which came forth from D.

Lastly, We may grant, that many Cracks might be made in the *Body E*, by the heat of the *Sun*; as we find that there are many Cracks in the *Ground* in *Summer time*, when it is parched by the *Sun*; and that these Cracks grow greater and greater, the longer that the *Drought* lasts: By which means its parts at last did so loosely hang together, that it was no longer able to hold up as an Arch between F, and B; but being broke to pieces, by reason of its *Heaviness* fell down upon the *Surface* of the *Body C*; and inasmuch as that *Surface* was not broad enough, for to receive all the *Fragments* lying together, so as to keep the same situation they had before, some of the said *Fragments* were forced to lye shelving one upon another. As for Example, If we suppose that in that part of the *Body E*, which this Figure represents, the chief Crack or Slits were so disposed in the places 1, 2, 3, 4, 5, 6, 7. that the two *Fragments* 2, 3, and 6, 7, should fall a little before the rest, and the ends of the four other *Fragments* 2, 3, 5, and 6, before the opposite 1, 4, and V; as also the End 5, of the *Fragment* 4 5, before the End V of the *Fragment* V, 6, there is no question but

VII.
The Forma-
tion of the
Fourth
Body.

VIII.
How a
Space was
left be-
tween the
Third and
Fourth
Body.

Figure
37.

IX.
How Cracks
or Slits
came to be
in the
Fourth Bo-
dy. And
how it
broke into
several
pieces.

Figure
38.

Figure
38.X.
That hence
was the
Original
of Moun-
tains,
Plains,
Seas, &c.XI.
The Earth
is a Round
Body.XII.
The same
proved
from the
position of
the Stars.XIII.
The Moun-
tains are
no Argu-
ment a-
gainst the
Round
Figure of
the Earth.XIV.
What we
are to un-

but they would be rang'd upon the Surface of the Body C, in the same manner as they are delineated, viz. so as that the Fragments 2, 3, and 6, 7, would be joyned next to the Body C, and the other four lye shelving on their sides, the one leaning upon the other, &c.

Further, if we consider that by the Body B, and E, here, the Air is to be understood; and by C, an inward very thick Crust of the Earth, from whence Metals are generated; by D, the Water; and lastly by E, the outward part of the Earth, which consists of Stones, Clay, Sand and Mud; we shall easily understand by the Water arising above the Fragments 2, 3, and 6, 7, the Sea; by other Fragments that are but a little leaning, and not cover'd with any Waters, as 8, 9, and V X, great Plains; and by others that stand more upright, as 1, 2, and 9, 4, V, Mountains. We shall also take notice, that when these Fragments by their own weight thus fell down, their extremities or ends forceably dash'd against each other, which made them fly into many less Fragments; which made great Stones on some Sea-shores, as at 1; and several tops of Mountains, partly very High, as at 4; partly Rising only, as at 9 and V; as also Rocks in the Sea, as at 3 and 6.

As to what belongs to the Figure of the Earth, it may be Mathematically demonstrated that it is Spherical; but forasmuch as Mathematical Demonstrations seem obscure to those who are ignorant in the Doctrin of Dimensions, it will here be sufficient to prove it to be so: First, Because its Particles are equally prest on all sides by the Heavenly Matter that surrounds it. Secondly, Because the Sun, who is at a great height above us, doth not enlighten all the Parts of the World at once, but first vouchsafes his Light to the Eastern Inhabitants, and afterwards to the Western; in which communication of his Light he observes this proportion, that those who live 15 Degrees nearer to the East, perceive his Light one hour sooner; and those who live 30 Degrees nearer, two hours, and so for the rest, observing the Proportion of 15 Degrees for each hour. Which could not be so, if the Earth were not of a Round figure.

The situation of the Stars also confirms this. For those Stars which are about the North Pole are always in sight; whereas those that are about the South Pole do not appear, except we move so far towards the South, as to be in the midst between both Poles: In like manner the Sun doth sooner Rise and Set to those that live more Eastward, than to those that live Westward, as appears by an Eclipse, which was seen by us at Midnight; and by those that liv'd Eastward, not till after 3 a Clock.

Neither is the Inequality of the Surface of the Earth, by reason of High Mountains and Deep Valleys, any Proof against its Roundness: For the Earth is not Mathematically Round, as an exact polish'd Globe, but Geometrically; inasmuch as all these Inequalities, compar'd with the Compass of the Earth, are no more an obstacle to its Roundness, than the unevenness of the Rind of an Orange spoils the Roundness of its figure.

By the Globe of the Earth, we do not only understand the Earth it self, but the Water also which covers a great part of it; seeing that the Parts of

both of them tend to the same common Center; and because the Surface of the Sea is continuous with that of the Earth; so that to those who Sail North or South, or Inhabit Eastward or Westward, the same Quarters of Heaven appear, or disappear. Which is an evident Proof, that the Surface of the Earth is not a level or plain, since those that set Sail do find, that the swelling Roundness of the Sea hides the Earth from them, and at last makes it altogether disappear.

Accordingly GASSENDUS well infers, that no two Plumb-Lines, or Perpendiculars, are exactly Parallel; and consequently, that no two Walls built by a Plumb-Line, are such, tho' they appear so to the Eye: For seeing that all Perpendiculars fall upon the Convex surface of the Earth, they must needs meet in the Center, in case we should suppose them to be drawn on at length, and consequently cannot be parallel.

Forasmuch as the Semidiameter of the Earth is a Measure, whereby we discover the magnitude and distance of the Stars; we are to take notice that one Degree of a great Circle doth contain 60 Miles on the surface of the Earth: By which Number, if we multiply the 360 Degrees that are in a whole Circle, we shall find that the Compass of the Earth consists of 21600 Miles. Besides, we are to observe, that when a Circle is divided into 22 parts, its Diameter contains 7 of them, and its Semidiameter 3 and an half: So that the whole Compass hath the same proportion to the Diameter, as 22 to 7. Wherefore the Diameter of the Earth consists of 7200 Miles, and the Semidiameter 3600 Miles.

From the Description we have already given of the Earth, it follows also that it must be Hard and Dry: For the Dryness and Hardness of any Body proceeds from the Resting of its Parts. As also, that it must be Cold: For seeing that its Parts have either but a very weak, or else no motion at all, neither can they be conceived to have any heat to speak of. It is necessary also that it should be Heavy: For seeing its parts have less Force than others, to recede from the Center of the Vortex wherein it is contain'd, they must needs be driven down towards it. So likewise it is Opaque, and reflects the Light it receives; by reason of the Interruption and manifold Windings of its Pores, not exactly answering to one another.

There are 4 kind of Pores, that are found within the Earth. The First whereof are such as are extended in length, but with wavings and turnings this way and that way. The second are strait Pores, whereof some have a hollow Surface, but rough and rugged, and others smooth and even. The third kind are those, that run into one another, and whereof one has often communication with many other Pores, upon which account we may compare them to the Branches of Trees. And lastly, the fourth kind of Pores are such, as are somewhat like Screws.

But tho' we have here deduced all the Pores of the Earth to four kinds; yet we allow that there may be infinite variety in one and the same kind, so that it may be there are not two Pores of one and the same kind, that are altogether like one another.

derstand
by the
Globe of
the Earth.XV.
There can
be no exact
Parallels
upon the
surface of
the Earth.XVI.
The Bigness
of the
Earth.XVII.
Other Pro-
perties of
the Earth.XVIII.
There are
four kind
of Pores
in the in-
ward parts
of the
Earth.XIX.
All the
Pores that
are of the
same kind,
are not
altogether
alike.

CHAP. II.

*The Earth is moved by the fluid Heaven,
that encompasseth it round.*

I.
The Com-
mon People
suppose the
Earth to
remain
immov-
able in the
midst of
the World.

THe Common People are not more obstinate in any Persuasion, than they are in that of the Earths Immobility; for they cannot imagine, that that which is the foundation and support of all things, should be moved; or that a Body of such prodigious Weight and Bulk should be carried about by another. Hence it is they believe, that the Sun and fix'd Stars are whirl'd round about us, and that the Earth rests immovable in the midst of the Heaven. Indeed our Eyes are not wanting to confirm this Persuasion; for we see that the Stars turn towards us from the East to the West, and that the Sun after the same manner insensibly approacheth to us.

II.
We must
not be too
apt to trust
our Senses.

But we ought to remember, that we must not too much rely upon the report of our Senses. For in this case it is with us, as with those that are in a Ship, who think that the Shoar departs from them, when indeed they themselves do depart from the Shoar. For to make a thing appear as if it were moved, it is all one, as ARISTOTLE saith, *Whether the Motion be in the Spectator, or in the thing that is moved.* Wherefore neither must it seem strange to us, who are carried about with the Earth, from whence we see nothing but the Roof of Heaven, and the Stars in a manner resting in their several Stations, that they do seem to draw near, pass by, and depart from us, the motion of the Earth being most steady and even. This is the Reason, that whilst Men look upon the Earth; they cannot conceive it to be moved; but when they turn their Eyes to any other Object, with regard to which the Interval is either increased or diminished, then indeed it seems to be moved: But our Sight, or rather our Mind, is more apt to ascribe it to the thing seen, tho' it be at rest, than to the thing that is moved, which it finds to be at no distance from it self. But that we may not seem to assert this without any grounds, we will enquire, Whether the Earth in it self have any Repugnance to motion; and if we find it hath not, Why should not we conclude that it is moved?

III.
The Obje-
ctions that
are made
against the
Motion of
the Earth.

Two things are only alledg'd against the Motion of the Earth, viz. its Bulk, and its Weight. For they Object, that all the parts of the Earth tend to the Center, where they are kept by the force of their Gravity. As we see that Stones and Metals rest in their several places, whence they cannot be removed without force, by reason of the propension they have to the Center. But that this Reason is not conclusive, appears from hence, that round Bowls or Bullets, made of Iron or Steel, are by a small Force made to trundle along a Plain or Level. Stones therefore and Metals continue in their places, not because they strive to tend towards the Center, but because they are firmly joyned to the Bodies whereon they lye; which Impediment is not to be found in the Earth, as being surrounded with the Fluid Heaven.

IV.
There is
no inward

Besides, we know that there is no Inward Gravity in the Earth, seeing that all Gravitation is caused by the Heavenly Globuli, which drive Ter-

restrial Bodies towards the Center; so that if we should suppose all the Space about the Earth to be fill'd with such Bodies, as did neither promote nor hinder the motion of other Bodies, and the Earth to be turn'd about its Axis in 24 Hours, all its Parts, which did not very closely stick together, would fly away on every side; as we find that Sand, which is cast into a Whirlpool, is every way dissipated. And accordingly we may rather account the Parts of the Earth to be Light, than Heavy.

Neither do I see what else can be understood by the Heaviness of the Earth, than a Quality whereby Bodies tending towards the Center of the Earth, have a tendency also to lye closer and cling together. Now such a Heaviness cannot hinder the Earth from being whirl'd about with the motion of the Heaven that surrounds it; no more than a Company of Men, being in a Boat that is whirl'd round, could hinder their turning round, by their mutual embracing and holding fast to one another.

Neither can the Bulk or Magnitude of the Earth hinder its motion: For the Bigness of a Body doth not deprive it of Mobility, which is a Property of all Bodies, and cannot be removed from them, except we should own all motion to be violent.

We must conclude therefore, that the Earth can be carried round by the Celestial matter that surrounds it. For seeing that according to our Supposition, the Vortex of the Earth hath been swallow'd up by that of the Sun; and that by this means the Earth hath been thrust down to that place where it now is, where it is surrounded with the Fluid Heavenly matter, always turning round, it cannot be otherwise but that the Earth must be carried about with it. This is clear of it self. Secondly, from the Nature of the Earth, which being a Planet, must not only be carried round by an Annual motion, in the surrounding Celestial matter; but also by a daily Circumvolution: For the Earth having formerly been a Star, may easily be conceived to have retain'd the motion it had before; and seeing that the subtil Matter in its Center doth turn round, it communicates that motion to the other Parts of the Earth, and makes the whole to turn round likewise.

But you'll say, What resemblance is there between the Earth and the Planets, seeing that it is the meanest of all other Bodies?

Yet for all this, if we consider the Form and Nature of the Earth, we shall meet with several Arguments to persuade us, that it is a Planet. For it is very like to the Planets in its bulk and bigness. Its figure also and situation prove the same; for it is as round as they are, and hangs pois'd in the midst of the Air. So also like them, it wants Light of its own, and shines only with a borrowed Refulgency from the Sun: And lastly, It is subject to the same Appearances, Aspects, Directions, Stations, Retrogradations, &c. For to pass by its various Reciprocations with the Moon, whatsoever Mercury and Venus do appear to the Earth, the same doth the Earth appear to Mars, Jupiter, and Saturn: And as Mars, Jupiter, and Saturn appear to her, so doth she appear to Venus and Mercury. Wherefore since the Planets are moved, why may not we conclude that the Earth, so far as it is

Heaviness
in the
Earth.

V.
The Hea-
viness of
the Earth
cannot
hinder its
Motion.

VI.
The Bulk is
no obstacle
to its
Motion.

VII.
The Earth
is whirl'd
round by
a daily
and daily
Rotation.

VIII.
An Obje-
ction a-
gainst the
Earth be-
ing a Plan-
et.

IX.
The Pro-
perties of
a Planet
do belong
to the
Earth.

is like them, must likewise move about its own *Axis*, and about the *Center* of the *Universe*. How does it appear then, that the *Earth* is the meanest and most ignoble of all *Bodies*; but only from that mistaken Opinion, that the *Matter* of *Heaven* is something that is *Divine*, and that the *Earth* is nothing else but the very Sink of the *World*? What can hinder the *Earth* from being as Noble a *Body* as *Venus*, *Mercury*, or any other *Planet*?

X. According to Tycho's Hypothesis, the Earth is moved most of all.

This Opinion will not seem strange to those that follow *TYCHO BRAHE*; for upon examining of his *Hypothesis* they will find, that he attributes more *Motion* to the *Earth* than we do. For supposing the *Earth* to be immovable, the *Heaven* and *Stars* must whirl round it in 24 *hours*; but this cannot be done, except that the Parts of the *Earth* be translated out of the Neighbourhood of those Parts of the *Heaven* which they touch; and forasmuch as *Motion* is nothing else than such a *Translation*, we may well conclude, that according to his *Hypothesis*, a *motion* must be attributed to the *Earth*. Yea, if we consider rightly of the *Matter*, we must conclude that the *Earth* is more moved than the *Heaven* it self; forasmuch as the *Earth*, according to its whole *Surface*, doth recede from the *Body* that surrounds it; whereas the *Heaven* only removes according to its hollow *Surface*, which is very little if compar'd with its *Convex Surface*. And thus according to *TYCHO*'s *Hypothesis*, there is an evident Reason for attributing a *motion* to the *Earth*; whereas the Reason whereby he attributes *Motion* to the *Heaven*, and *Rest* to the *Earth*, is altogether uncertain, and forged by his own Imagination.

XI. The Motion of the Earth produces no diversity of Aspect in the fix'd Stars, because of their vast distance.

You'll say, If the *Sun* has its position amongst the *fix'd Stars*, and the *Earth* be moved round it, it is necessary that the *Earth* must at some times be nearer to them, by the whole Space of its *Orb*, than at other times; but the *Appearances* make out no such thing to us.

To which I Answer, That this Difficulty will vanish, if we consider the vast Distance that is between us and the *fix'd Stars*, which is so very great, that the whole *Orb*, which is describ'd by the *Earth* about the *Sun*, is but a *Point* compar'd with it. Which tho' it may seem to be incredible to those, who are not us'd to consider the wonderful Works of *GOD*, and who look upon the *Earth* as the chiefest part of the *World*, and the *Habitation* of *Man*, for whose sake all other things were made: Yet can it not seem so to *Astronomers*, who are well acquainted with these things.

XII. The Globe of the Earth is of an imperceptible Magnitude, when compar'd with the vast Compass of the Starry Heaven.

From hence also we may easily answer the Objection of some *Astronomers*, alledging, That if the *Earth* were not in the midst of the *World*, the whole *Hemisphere* could not appear to us, or the one half of the *Heaven*, and especially of the *Zodiack*, which always contains 6 *Signs*. For these Men do not consider, that the whole *Earth*, compar'd to the *Heaven*, is of an insensible Bulk. Which thing *PYTHAGORAS* and *COPERNICUS* do not only affirm concerning the *Earth*, but also of the *Annual Orb*, compar'd with the *Heaven* of the *fix'd Stars*: For they assert, That 2 *Plains*, whereof the one being drawn through the *Sun*, the other through the *Surface* of the *Orb*, as *Horizontal*, would appear to meet together, because of the vast Distance: So that by that time they reach the *Heaven*, notwithstanding

that they are terminated at *Circles* so greatly distant from each other, as is the *Sun* from the *Earth*, they will seem to end at the same indivisible *Point*; neither doth the amplitude of the great *Orb*, hinder us from seeing the whole *Hemisphere*, and whole 6 *Signs* of the *Zodiack*.

In the second place you'll Object, That it hath been asserted in the *General Physicks*, that a *Body* which is turn'd round, doth endeavour, as much as in it lies, to recede it from the *Center*: How then comes it to pass, that *Castles* and *Steeple*s are not cast off into the *Air* by this Circular motion of the *Earth*?

It is Answered, That all the Parts of the *Earth* are on all sides prest down towards the *Center*, and hindered from flying loose and being scatter'd abroad: For the *Heavenly Globuli* moving by right *Lines*, or such as little deviate from them, drive with great force against the *Earth*; and thus thrusting all its Parts towards the *Center*, hinder it from flying out towards the *Heaven*: For seeing that the *Heaven*, which lies between the *Earth* and the *Moon*, is much more swiftly carried about the *Earth*, than the *Earth* is carried about its *Axis*: And since the *Particles* whereof the *Heaven* consists, are most fluid and variously agitated in right *Lines*, or approaching thereto, they with great force strike against the *Earth*, by which means all the parts of the *Earth* are compress'd and thrust towards the *Center*.

CHAP. III.

The Earths Motion established by other Arguments.

I. Forasmuch as it is evident from what hath been said already, that the *Earth* of it self hath no repugnance to *Motion*; and that neither its Bulk, or *Heaviness*, can hinder it from being carried about by the fluid *Heaven*: It remains now that we superadd some *Reasons*, which have not only induced our Modern *Mathematicians*, but also the *Ancients*, to favour this Opinion.

But before I enter upon these Arguments, I would desire such as are free from Prejudice, to contemplate the vast extension of the *Heavens*, and compare the same with the small Bulk of the *Earth*, which is so many Thousand times less: (For even the Common Opinion admits the Circumference of the *Firmament* to exceed that of the *Earth* 50000 times) Next, let them consider the swiftness of that *Motion*, which we must necessarily allow to those high *Bodies*, if we suppose them to be whir'd about the *Earth* in the space of 24 *Hours*. Which being attentively consider'd, I question not but they will be more inclin'd to think the *Heavens* immovable, and that the *Earth* by its *Diurnal motion* is turn'd round the *Sun*, than that the whole *Universe* is snatch'd round about it, with a swiftness that is altogether unconceivable.

For the *Mathematicians* do allow, that the *fix'd Stars* are distant from us 14000 *Semidiameters* of the *Earth*. And since, according to *ARCHIMEDES* his Computation, the *Semidiameter* of the *Earth* consists of 859 *German Miles*, every one of which contains 4000 *Geometrical Paces*, or 20000 *Foot*, the Circumference of the *Sphere* of

XIII. How it comes to pass, that this Motion of the Earth, doth not overturn Houses and Buildings.

XIV. The Answer.

I. The Earth hath no Repugnance to Motion.

II. The vast Extension of the Heaven, and the Littleness of the Earth, are to be well consider'd.

III. The Motion of the Stars is incredible.

of the fix'd Stars will be of 75592984 German Miles. And seeing all this Space must be run over in 24 hours, in 1 hour the 24th part of it must be dispatch'd, that is, 3149066 German Miles; in the 60th part of an hour, or a first Minute, 52494 German Miles; in a second minute, that is, the 3600th part of an hour, 874 German Miles, that is, 3496 Italian Miles, or 3496000 Geometrical Paces, or 174900000 Foot, which is inconceivable in so short a Space.

IV.
The Earth's Motion, proved by an Argument drawn from the Ptolemaick Hypothesis.

A strong Argument for the Earth's Motion, may likewise be drawn from the PTOLOMAICK Hypothesis. For according to it, the Heavenly Bodies are moved more slowly or swiftly, according to their Bulk; they that are less in Bulk performing their Revolution in less time, than those that are of a greater Bulk. Thus Saturn, the highest and biggest of all the Planets, takes up almost 30 years in running through his Orb; Jupiter 12, Mars 2; and so of the rest, according as the Orbs they are to run over, are nearer or further from the Earth: But if we suppose the Immobility of the Earth, all this Order must be overthrown, since not only Saturn, but all the Intermediate Planets between him and the Earth, must be hurl'd about in 24 hours: All which things are contrary to the Phenomena.

V.
The Motion of the Earth, makes for the Beauty and Order of the World.

But supposing the Earth to be moved, all these things are sav'd, and the comely Order of the Universe preserv'd and establish'd. Seeing that we may proceed from the Earth, to those Bodies that are more slowly moved, without any confusion, till we come to the Heaven of fix'd Stars. Or if any one should assert the fix'd Stars also to be moved, thence will follow another Absurdity, viz. that their Motions will be unequal. For some of them that are in the Greatest Circles will be most swiftly moved, and others in the least Circles, with a very slow motion, according as the said Circles shall be further from the Ecliptick, and nearer to the Poles. Now what can be more absurd, than to suppose Bodies to be moved at the remotest distances from the Center, and yet to assign the least Spaces to their motions?

VI.
If the Earth be immovable, there must be two contrary Motions in the Heavens.

Moreover, all those who are of the contrary Opinion, hold, that the Determination of a motion towards one part, and its meeting of another Body, resting, or otherwise moved, are contrary to one another: Now supposing that the Heaven is moved, we shall find divers motions in it, one from East to West, and another from West to East. For the Heaven, according to them, is most swiftly whirl'd towards the West; and the Planets from West to East; which two motions are Diametrically opposite. Now, it is impossible for one and the same Body to be carried divers ways by contrary Motions: For if a Body be carried from East to West, it cannot at the same time be carried from West to East.

VII.
These Difficulties are removed by the Motion of the Earth.

But what still more surpasseth our Apprehension is, How it is possible that whilst the Heaven is with such incredible swiftness hurl'd about, the Planets should in spite of it perform their Courses in a quite contrary motion to it; especially seeing that their motion, compared with that of the Heaven, is very slow, and therefore may be easily overpower'd by a stronger motion. But by attributing a Motion to the Earth, all this contrariety of motions ceaseth, and we have no more than one

motion, viz. from West to East, which way the Earth and all the Planets are carried.

The great Force also of the Motion of the Heavens, asserted by the Followers of PTOLOMAEUS his Opinion, is a strong Argument to prove the Diurnal Circumvolution of the Earth; for they must allow it to be so powerful, as to whirl about with it not only the Planets, but also the fix'd Stars. Now if it be so that all Inferiour Bodies are forc'd to follow the motion of the Highest Heaven; and that the Element of Fire, and a great part of the Air, cannot resist its motion, how is it possible that the Earth that hangs in the midst of the Air, and is indifferent to Motion, or Rest, and surrounded with fluid Matter, should for all that alone remain immovable, and resist so vast a Force? This, according to my sense, seems utterly inconceivable; for by what Ropes or other Holdfasts, is it kept immovable in this Aethereal Ocean? For altho' the Heavenly Matter be liquid, and doth not push against other Bodies, with as much force as hard Bodies do; yet neither can it be denied, but that the motion of fluid Bodies, when determin'd to some one part, doth carry along with them whatsoever Matter is contained in them, how solid or compact soever it may be, except it be detained by some outward Force. As we see that great Stones, by the strong Current of Rivers, are carried along to a vast distance, except they be stop'd by the unevenness of the Bottom, or some other Obstacle. Now all these Difficulties vanish by ascribing to the Earth, which is a very little Body, yea, imperceptible, if compar'd with the Universe, and unable to cause any Change in the World, a motion round its own Center.

Moreover, what shall we assign to be the Cause, that keeps the Earth immovable? Is it by some Force? But where shall we look for this Force? or what is it? Is it a Natural Force, depending on the Divine Order and Constitution, settled in the first Creation, and consequently the ordinary Providence of GOD? Or is it an immediate Hand of GOD? It cannot be the ordinary Power of GOD: For the Order of Nature is this, that where Bodies that are near and far off, are hurried away by another Body, there also that which intervenes between those that are near and far off, must be carried about also, except something hinder it. Let us suppose Lines to be drawn from the Sun through the Earth and Planets; by which Lines we are to conceive the Sun-beams to be diffus'd, according to TYCHO, that by them he may carry about with him the Upper and Lower Planets; if therefore he snatcheth the superiour Planets along with him, must not he of necessity do the same for the Earth, which is in the midst between them? Neither can this be said to be done by the immediate Power of GOD, since TYCHO himself never thought fit to have recourse to any such Power, for the making out of his Hypothesis.

The Light of Nature also seconds our Opinion; for those Bodies are supposed to be of different Natures, which are endued with different Affections: Thus Lucid and Opake Bodies are distinguish'd in their Composition, because they have distinct Properties. Wherefore seeing that the Planets, of whose number the Earth is, are solid and

VIII.
'Tis incredible that all the Heavens should be moved about the Earth, and that it should be immovable.

IX.
It is also contradictory to the Order of Nature.

X.
The Sun being the great Lamp of the World, it would be absurd to conceive it plac'd in a Corner.

and destitute of all *Light*; it is necessary that the *Sun* and *fix'd Stars* should continue unmoved, and that the *Earth* and the rest of the *Planets*, should move round him, to partake of his *Light*. For as it would be absurd to place a *Light*, that is to enlighten a *Church*, in some *Corner* of it, and not in the *middle*: So the *Sun* being design'd to be the *Great Light* of the *Universe*, by which other *Bodies* were to be illuminated, it was to be placed in the *Center*, and not in one of the *Sides* of it. And accordingly we must conclude, that the *Sun* stands still, and that the *Earth*, with the rest of the *Planets*, are carried round him.

Besides, I cannot conceive what Reason some *Philosophers* could have, to maintain the *Earth's* Immobility, seeing that the same Effects follow, whether its *motion* be allow'd or deny'd. For the *Sun* seems to us to run through the *Zodiac* after the same manner, notwithstanding that he rests in the *Center* of our *Vortex*: For wheresoever the *Earth* is, the *Sun* being look'd upon from it, will always hide that *Sign*, in opposition to which the *Earth* is placed. Thus when the *Earth* is in *Libra*, the *Sun* is seen in *Aries*; and when the *Earth* passeth from *Cancer* to *Leo*, the *Sun* is seen to pass out of *Capricorn* into *Aquarius*.

For seeing that no relation can be fixt between *Bodies* that are in *motion*, and it is necessary that some be *moved*, and others *stand still*, that we may be able to form some respect between them: The same Appearances happen to us, whether we suppose the *Earth* only to be *moved*, or the *Heaven* with the *Circumambient Bodies*; forasmuch as by this means the Relation only of a *Body* moving and at rest, is varied, the same effect being indifferently produc'd by either of them, as to us. Now this being supposed, it will not be easie for any one to believe, that *Nature*, which always proceeds the most short and compendious way, should have chosen to perform that by the unconceivable *motion* of so many vast *Bodies*, which she might, without all that ado, have brought about by the alone *motion* of the *Earth*.

These and other like *Arguments*, which I might alledge, are sufficient, as I suppose, to prove that the *Earth* moves, at least to those who listen to Reason, rather than Authority; especially if they consider, that the *Globe* of the *Earth* is turned round together, with the Neighbouring *Bodies* of *Water* and *Air*. For as the *Water*, as hath been said already; so likewise the *Air* makes a part of the *Terrestrial Globe*, and may be conceived to have the same respect to the *Earth*, as the *soft Down* that grows upon a *Body* hath to it.

CHAP. IV.

The Objections answer'd, which by ARISTOTLE and others, are framed against the Motion of the Earth.

AS *Lucid Bodies*, compar'd with such as are *Opake*, do thereby appear the clearer; and as the *Sun* shines brighter, when newly got from under a *Cloud*: So I question not, but that this Opinion concerning the *Earth's motion*, will appear more plausible by a Refutation of the Objections that Adversaries make against it. Amongst those who oppose this Opinion, ARISTOTLE is the

Chief; a Man of a great *Wit*, and fit for the Contemplation, not only of *Earthly*, but *Sublime things*: Who 'tis like, had he liv'd in these our days, would either have been of our *Opinion*, or at least have better refuted the *Arguments*, which are brought to overthrow the stability of the *Earth*.

The First Argument he brings against us is, That this *Circumvolution* of the *Earth* is not a *Natural*, but a *Violent motion*; because it is repugnant for that to agree *Naturally* to any thing, that doth not agree to all its parts likewise. Now it is evident that the Parts of the *Earth* do not move so, for they are carried in a *strait Line* to the *Center*; wherefore *Circular motion* cannot be said to be *Natural* to the *Earth*, and therefore much less to be everlasting.

This Objection is easily answer'd, by saying, That the word *Violent* doth not at all belong to *Natural things*, forasmuch as they are indifferent to *Motion* or *Rest*; and it is no less *Natural* for *Bodies* to be *moved*, when they are push'd forwards by an *External Agent*; than it is for them to *rest*, when they are not push'd out of their places. It belongs only to our *Will* to suffer *Violence*, when any thing is done that is contrary and adverse to it. But let us grant that *Violence* may be attributed to *Bodies*, and that there are certain *Inclinations* in things, by which they prosecute the *Ends* they are design'd for; yet cannot we conclude thence, that the *Earth* is moved against *Nature*, because its parts are moved downwards by a *strait*, and not by a *Circular motion*: For this is to be understood of the parts of the *Earth*, separated from the rest of the *Globe*; and thus consider'd, it is not necessary that they should be in all things like unto the whole: No more than it is necessary, that all the *Particles* of the *Earth* should be *round*; or every part of a *Circle*, make a *Circle*, because the whole is *Round*, and the *motion* of the whole constitutes a *Circle*: But only that the parts of the whole be moved together with it; and like as the *Globe* of the *Earth* is whirled about in 24 hours, so all the parts that compound it, be in the same Space carried about its *Center*.

Which *Motion* may be no less Everlasting to the *Earth*, than any other *motion*; yea, and more too, if we attend to the Nature of *Strait motion*. For it is certain, that the *Earth* cannot move for ever upwards or downwards: But what can hinder that a *Body* may move *Round* continually, supposing the same cause that produceth it at first, to persevere? Wherefore, according to our *Principle* we are to assert, that no *force* or *violence* is to be found in its *Nature*; and that it is no less *natural* for *Bodies* to move *Round*, than to move in a *strait Line*, upwards or downwards, or any other way whatsoever.

The *Heaviness* of *Bodies* seems of all other things to be most contrary to the *Circumvolution* of the *Earth*. For *Heavy Bodies* do from on high, fall to the *Earth* by a *strait Line*: Now supposing this *Circular motion* of the *Earth*; how can it be, that a *Stone* let fall from the *Top* of a *Tower*, should fall down plumb to the *Bottom* of it, when in the mean time that the *Stone* is falling down, the *Earth* that bears the *Tower* moves many *Cubits*; and therefore the *Stone*, in case the *Earth*

II. Aristotle's Objection, drawn from the Nature of Natural and Violent Motion.

III. The word Violent doth not belong to Natural things.

IV. Nothing hinders, but that the Motion of the Earth may be Everlasting.

V. The second Objection, from the Heaviness of Bodies.

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XI. The same Effects follow, whether the Earth be supposed to move or stand still.

XII. Some Bodies will rest, or stand still, for to be able to judge of the motion of another Body.

XIII. The Air and Water are whirled about with the Earth.

I. Objections afford a greater Evidence, to discern the truth of the matter in question.

VI.
A Stone
falling
down from
the top of a
Tower, is
carried by
a twofold
motion.

were moved, would not light at the foot of the Tower, but a good distance from it, which is contrary to daily experience.

This *Objection*, tho' accounted of great weight by our *Adversaries*, is nevertheless ealie enough to be answered, if we consider, that in every *Heavy Body*, besides its *motion downwards*, there is another imprest upon it, from the *Earth*, whirling round about its own *Axis*, whereby not only it self, but the *Bodies* that are about it, are carried along. There is therefore a twofold *motion* in a *Stone* that falls from a *Tower*, the one a *straight motion*, whereby it falls down to the *Ground*, the other a *circular*, whereby the *Earth* is carried along with the *Celestial matter* that surrounds it; and therefore it is not necessary that a *Stone* fallen down from a *Tower*, should fall at a distance from it, since both of them are carried about with the same swiftness, and the *Stone* cannot but fall plumb down at the foot of the *Tower*. For it is no contradiction in *Philosophy* for one *motion* to be compounded of a straight and circular. *ARISTOTLE* himself owns as much, when he attributes to the *Fire* a *straight motion*, by which it is carried upwards; and a *circular*, in which it is carried about the *Earth* by the *supream Heaven*. A *Stone* therefore falls plumb down to the *Earth*, because with respect to the *Stone* it is all one, as if it were not mov'd at all, seeing that the *Air* and all the *Bodies* contain'd in it, are prest down by the *subtil matter*, and are whirl'd about together with the *Terrestrial Globe*. This is proved by a *Stone* falling from the *Mast* of a *Ship*, which whether it move, or stand still, the *Stone* ever falls down in the same place. The reason whereof is plainly this, because the *Stones motion downwards*, which it derives from the *Celestial matter*, is accompanied with a *Lateral motion*, communicated to it by the *Ship*, which is swiftly driven along. And consequently it is not strange at all, that it falls down *perpendicularly*, because the *Stone* moves as much forwards as the *Earth*, and consequently one and the same point of the *Earth* ever answers to the *Stone*, and therefore upon it the *Stone* must needs fall.

VII.
The motion
of a Stone
falling
down is not
straight,
but accord-
ing to a
Paraboli-
cal Line.

Tho' indeed to speak exactly concerning these things, we must own, that *heavy Bodies* do not fall downwards by a *Right*, or *Perpendicular Line* to the surface of the *Earth*, but by a kind of *Transverse* or *Crooked*, called a *Parabolical Line*: and the Reason why the *motion* of a *Stone* appears to be *Right* and *Perpendicular*, is, because the *Eye* doth not perceive that *motion* whereby it self is moved, and which is common to it with the *Stone*, but only that *motion* which proceeds from the *Action* of *Gravitation*, or which is imprest upon the *Stone*, by him that casts it.

VIII.
A Third
Objection
from the
Shot of a
Gun.

Against this Solution it may be, will be urged an *Argument* taken from the *Shot* discharged out of *Great Guns*, viz. how it comes to pass, the *Earth* being moved about its own *Center*, that a *Bullet* discharged from the *East*, should not move more slowly than another that is discharged from a like *Gun*, and an equal quantity of *Powder* from the *West*? For if the *Earth* be carried from *West* to *East*, it must necessarily follow that the *Bullet* discharged from the *West*, must much exceed the swiftness of the other, as being assisted and promoted by the *Circumvolution* of the *Earth* the same

way; whereas the other is as much obstructed by the same, because it moves a quite contrary way.

I Answer in the *First Place*, that when a *Bullet* is discharged towards the *West*, as much as the *Earth* moves towards the *East*, so much is the *Bullet* also driven back that way, by the common motion of the *Vortex*: and on the contrary, when a *Bullet* is discharged towards the *East*, as much as the *Earth* has the same way, so much is the *Bullet* retarded by the *Vortex* of the *Earth*.

I Answer in the *Second Place*, that the *motion* of the *Earth* which is common to it with the *Air*, and other *Bodies* contained in it, doth neither hinder nor promote the *motions* of particular *Bodies*; and consequently, that all things happen in the same manner, as if the *motion* of the *Earth* were not determined to any certain part. As is manifest from this *Example*. Suppose we, a *Boat* to be driven with great swiftness to some particular *Region*, and one part thereof to be full of *Water*, in which two *Fishes* are swimming, the one from the *East* to the *West*, and the other from *West* to *East*; no body will imagine, that that *Fish* whose motion conspires with that of the *Boat*, will therefore move faster than the other. For it is certain, that which way soever they move, it will be with equal swiftness, as if the *Boat* were not moved at all. Thus the *motion* of the *Earth* from *West* to *East*, is no hinderance at all to those *Bodies* that move the contrary way. Yea the motion being common, its the very same, as if there were none at all.

For as these *Fishes*, besides the motion they have from their *Animal Spirits*, whereby they are carried which way they please, have also a motion imprest upon them from the *Boat*: In like manner a *Bullet*, besides that *motion* communicated to it by the *Gunpowder*, which carries it straight forward, hath another *motion* imprest upon it by the *Earth*, whereby it is whirl'd about in the same swiftness with it from *West* to *East*, and therefore runs through the same spaces as if there were no motion at all in the *Earth*.

Others again raise this *Objection* against the *motion* of the *Earth*: Supposing the *circumvolution* of the *Earth*, say they, there would always be a sensible Breez of *Wind* upon the *Surface* of it, as we perceive when we ride on *Horseback*, we are sensible of a kind of a Breez of *Wind* coming against our *Faces*, because the *motion* of the *Horse* exceeds the *motion* that is in the *Air*. Accordingly what a strong Breez of *Wind* ought we to feel, if with so swift a whirling about, as that of the *Earth* is supposed to be, we should run against the opposing *Air*? Wherefore seeing we find nothing of this, we have reason to conclude, that there is no such motion at all.

But this *Objection* is not so much the effect of *Reason*, as of an inveterate Prejudice about the stability of the *Earth*, which makes it a difficult thing for some men to conceive, that the *Air*, with all other ambient *Bodies* to the *Moon*, are carried about together with the *Earth*. Whereas, to speak exactly, the *Heavenly matter* that carries the *Earth* along with it, is more swiftly moved about the *Earth* than the *Earth* it self is about its *Axis*. Wherefore, in this Case, no wonder if we feel no *Wind* at all, no more than it is strange that a man that

IX.
The An-
swer.

X.
A common
or general
motion is
no obstacle
to particu-
lar motions.

XI.
The motion
of a Bulle
discharged
from a Gun,
compared
with the
motion of
Fishes in a
Boat.

XII.
A fourth
Objection
from the
Nature of
the Wind.

XIII.
Forasmuch
as all the
Bodies up
to the Moon
are moved
together
with the
Earth, it
cannot seem
strange
that we
feel no wind
from the
motion of
the Earth.





that pursues us with a *Sword* doth never reach us, in case we move faster than he.

XIV.
A Fifth
Objection
from Holy
Scripture.

The Authorities taken from *Scripture* seem to be of more force against this Opinion: For the *Scripture* in many places attributes stability to the *Earth*, and to the *Sun* a motion from East to West, as in the 1st Chapter of *Ecclesiastes*, where it is said, *The Sun ariseth, and goeth down, and hasteth to his place where he arose.* And in the Book of *Joshua* it is reported for a *Miracle*, that the *Sun* stood still at the Prayer of *Joshua*, when he said, Chap. 10. 12. *Sun, stand thou still upon Gibeon.* Now this would not have been a *Prodigy*, if the *Sun* had always stood still in the midst of the *World*, and the *Earth* had whirled about it; for if so, it had been more proper for *Joshua* to have said, *Earth, be not thou moved.*

XV.
The Scrip-
ture in
many places
accommo-
dates it self
to our man-
ner of con-
ceiving of
things.

To which I Answer, That it is generally owned, that the *Scripture* speaks of things according to the manner of men, that is, our way of conceiving them. As when the *Scripture* speaks of the *Ends* and *Foundations* of the *Earth*, neither of which do properly belong to it. In like manner, when it attributes to the *Sea*, an *Abyss* of an unmeasurable depth, with other various *Affections* and *Motions*, which it hath not. Thus likewise it is said in the 1st Chapter of *Genesis*, that *God made two Great Lights, the Greater to rule the Day, and the Lesser to rule the Night.* Which can only be understood as to outward appearance, and not according to exact *Truth*. Because the *Sun* and *Moon* are not the greatest *Lights*, especially not the *Moon*, for *Saturn* and any of the *Fixt Stars* are greater than it. Neither can the *Moon* be called absolutely the least *Light*, seeing that *Mercury* is much less. And therefore we must conclude, that the *Scripture* calls them so, only because they appear so to us, and are accounted so according to vulgar opinion. And upon the same account it is, that the *Earth* in *Scripture* is said to stand still, and the *Heaven* to move about it; because, as to our sight, the *Earth* seems rather to stand still, and the *Sun* to be whirled about it, than the contrary. The same thing happening to us in this case, as to those that *Sail*, to whom the *Shoars* seem to withdraw, tho' indeed they withdraw or depart from the *Shoar*. When therefore *Joshua* said, *Sun, stand thou still*, this is not to be understood, as if the *Sun* then had been stopt in his motion, and made to stand still; but only that the *Light* of the *Sun*, at *Joshua's* Prayer, continued without change, by which means the *Body* of the *Sun* seem'd to stand.

XVI.
The Obje-
ction far-
ther urged
from Scrip-
ture.

If it be urged, that this Explication cannot be admitted, forasmuch as in many other places of Holy *Scripture* the stability of the *Earth* is plainly asserted: As in the 92^d. Psalm, *The Earth is established, that it cannot be moved*, and the 1st. of *Ecclesiastes*, *One Generation passeth away, and another cometh, but the Earth standeth for ever.* For how can the *Earth* be said to stand fast for ever, when indeed it is continually in motion?

XVII.
The Obje-
ction an-
swered.

I Answer, that these places are not so to be understood, as if the *Earth* were immoveable, and did not turn about its own *Axis*, but only that there is such a firm and indissoluble union of its parts, that it continues the same, notwithstanding the perpetual generation and corruption of *Animals*, *Plants*, and other things that are upon

it. So as that passage of the *Poet* may be attributed to the *Earth*.

*The same that our Progenitors did see,
The same is now, and still shall be.*

And that this is the genuine sense of this place, plainly appears from the foregoing words, *one Generation passeth away, and another cometh.* As if it had been said; tho' the *Earth*, according to some of its parts, be changed by means of *Generation* and *Corruption*, yet it standeth for ever, that is, it always continues in the same state: Much after the same manner as a *Ship* is said to continue the same, though it hath been often repaired, and several new Parts put instead of the old and decayed.

CHAP. V.

Concerning Day and Night, and the Vicissitudes of Seasons.

A Day is commonly taken by *Philosophers* for the stay of the *Sun* above the *Horizon*: In which sense it is opposed to *Night*, which is the abode of the *Sun* under the *Horizon*. Or else a Day is taken for that Duration in which the *Sun* is conceived to run round the whole *Earth*. The *Astronomers* call the former of these an *Artificial*, and the later a *Natural Day*, as containing both the *Artificial Day* and *Night*.

A *Natural Day*, is either *Astronomical* or *Civil*. An *Astronomical Day* is that space of time, wherein the whole Revolution of the *Aequator* is absolved, together with that portion of the *Aequator*, which answers to that part of the *Ecliptick*, which the *Sun* in the same time is understood to run through. The *Civil Day*, is that which is determined as to its Beginning and Ending, according to the custom of particular *Cities* or *Nations*. Thus the *Italians* begin their *Day* from *Sun set*; the *Babylonians* from the *Rising* of the *Sun*; the *Umbrians* from *Noon*; the *Romans* from *Midnight*, &c.

A *Year*, which consists of *Days* and *Nights*, is that time, wherein the *Sun* runs through the whole *Ecliptick*, or all the Signs of the *Zodiack*; which it doth in 365 days, 5 hours and 49 minutes; Which form of the *Year*, that it might be observed throughout the whole *Roman Empire*, *Julius Caesar* appointed that the 5 hours, with the 49 minutes, which the *Year* contained over and above the 365 days, should every fourth *Year* make one *Day*, which should then consist of 366 *Days*.

But forasmuch as these 20 hours with their minutes could not make up a whole *Day*, it was so ordered that those minutes which were added to every *Year*, over and above the due length of it, by process of time were so increased, as by exact computation to amount to 10 days. And consequently also the *Vernal Equinox* had changed its place, so as that the *Sun*, which entered *Aries* at the beginning of *Christianity*, on the 21st day of *March*, did about 1500 years after, enter the same about the 11th. day. To remedy which error, *Pope Gregory XIII.* restored the *Equinox* to its former Seat, and by taking away 10 days, made it to return to the 21st of *March* again. Which is the Reason

I.
What a
Natural
and Arti-
ficial Day
is.

II.
A Natural
Day is ei-
ther Astro-
nomical or
Civil.

III.
What a
Year is.

IV.
Why a Year
is not the
same every-
where, and
why the
English dif-
fer in their
computati-
on from
some other
Nations.

V.
A threefold
Revolution
of the
Earth.

VI.
The Diurnal
motion
of the
Earth.

VII.
The Annual
motion.

VIII.
The Earth's
motion of
Inclination.

IX.
This three-
fold Motion
of the
Earth ex-
plained.

Reason why we here in England, not receiving this Reformation of the Kalender, differ 10 days from the account of others; so that when in France it is the 11th. day of March, it is no more than the 1st. day with us, and so on.

Forasmuch as the Diversity of the Days, Nights and Seasons of the Year, are consequent upon the motion of the Earth; we are to take notice of a threefold motion in the Earth, viz. A Diurnal, Annual, and Motion of Inclinations.

The Diurnal motion, is that whereby the Earth is whirl'd about from West to East, in the space of 24 hours. This motion, according to our Hypothesis, doth not properly belong to the Earth, but to the fluid matter, in the midst whereof the Earth being poised, is together with the Atmosphere, carried about, not by a motion of its own, but of the Fluid Heaven that surrounds it: so that according to DES CARTES his Opinion, motion doth not properly belong to the Earth, but to the little Vortex which carries the Earth round with it self.

The Annual motion, is that whereby the Earth runs through the Ecliptick in a years time; which motion is also imparted to it by the Fluid matter, whereby it is pois'd, which being whirl'd round by the force of the Solar matter, doth necessarily carry about with it all the Bodies that Swim, or are poised in it. The Earth therefore being carried about the Sun, between the Orbs of Venus and Mars, runs through the 12 Signs of the Zodiac in a years time. Now how the Earth can, besides its turning round, about its own Axis, perform a circuit about the Sun, we may learn by the Example of a Top, which turning round upon your Hand, may by you in the mean time be carried round a Tree, without hindring the motion of it about its own Center.

The motion of Inclination or Declination of the Earth, is the Deflexion of its Axis, from a Parallelism with the Axis of the Ecliptick, and ever keeping it so in every Situation, that it may always continue Parallel to the Axis of the World. So that indeed this motion, is not so much a distinct motion from the foregoing motions, as a certain modification of them; for whilst the Earth absolves its Diurnal and Annual motion, it always hath its Poles directed to the same parts of Heaven.

These three motions of the Earth will be apprehended without difficulty, by comparing the two former to a Bowl delivered out of ones Hand, and rowling along the ground: and the third to a Flag fixt to the Mast of a Ship, but so, as to be able to turn round, in which Flag we suppose the Globe of the Earth to be painted, with its Axis, not placed right upwards, but somewhat leaning on one side, parallel with the Axis of the Terrestrial Globe. Now suppose a Ship, in which a Mast and Flag is, were to sail round some Castle or Fort, a strong South Wind blowing, it is manifest that this moveable Flag on the top of the Mast, would not turn about with the Ship, but by the force of the Wind, would be always directed towards the North, together with the Axis painted in it. So that by that time the Ship, pursuing its course, had performed one round, about the Fort, the Flag also would have perform'd one round, about the Iron Pin to which its fastned,

contrary to the motion of the Ship; the Axis of the painted Globe of the Earth being still directed towards the same part of Heaven.

The Orb, whose middle Line the Earth, by its Annual motion describes, is called the Great Orb, which with regard to the fix'd Stars is but like a Point, according to our Hypothesis, so great is the distance between the fix'd Stars and the Earth; and therefore 'tis all one, whether the Stars be viewed from the Center of this Great Orb, or from the Circumference. And thus much will be readily admitted by those who consider how rash a thing it is, to define the Works of GOD to be less August and Ample, than indeed they are; and especially if we consider, that the Appearances can no other way be explained; neither doth Reason oppose it, seeing that the whole Earth is but a Point, compar'd with the Sun: Which is prov'd by this Instance, because the Sun seems to move about a Round Sun-Dial placed upon the Surface of the Earth, after the same manner as it Rolls about the Earth; which shews, that the Diameter of the Earth is of no account in this case.

It is to be noted also, that the Axis about which the Earth, in a Days time, turns round, is not perpendicularly rais'd above the Plain of the Ecliptick, in the which, in a years time, it is whirl'd about the Sun; but declines above 23 Degrees from a Perpendicular. The reason whereof is, because the striate Matter of the first Element, which enters into the Poles of the Earth, near to the Poles of its Axis, coming from that part of the Vortexes which constitute the second Heaven, doth in this manner inflect or turn it aside: The other Parts of the Earth having not their Pores so dispos'd, that other subtil Matter, coming from other parts of Heaven, should enter into them, and turn it another way.

The Necessity of the Motion of the Axis of the Earth appears from hence, that without it there would be no inequality of Days and Nights, but the Inhabitants of the same place would always have the same length of Days and Nights, and the same constitution of the four Seasons of the Year; that is, some would have all the year, Winter, others Summer, others Autumn, and others Spring. Wherefore it is of absolute necessity to admit the motion of Inclination, to save the Appearances, and to make all things agree in Harmony.

Forasmuch therefore as the Earth is a great Spherical Body, and at a great distance from the Sun, its whole extension cannot be enlightned at once, but only one half of it; and therefore when the Earth is once carried about its Axis A B in the space of 24 Hours, it makes the same part of the Earth, when turn'd toward the Sun, to enjoy Day-light; and when turn'd away from him, to have Night. For Day is said to be in that Part of the Earth, which being turn'd to the Sun, receives its Rays; and Night in that Part, which being turn'd from the Sun, cannot immediately receive them. And therefore it is no wonder, if the Parts of Heaven seem to arise and go down; because by the Revolution of the Earth they are gradually discovered, and seem in order to approach towards us; and on the opposite side to set and vanish.

And

X.
The Great
Orb, is but
a Point
in compa-
rison with
the fix'd
Stars.

XI.
The Pole of
the Earth
declines
23 Degrees
from the
Pole of the
Ecliptick.

XII.
Without
the motion
of Inclina-
tion, there
could be no
difference
of Season.

XIII.
How Day
and Night
come to be

Figure
39.

XIV.
Whence
the diver-
sity of Sea-
sons of the
Year ar-
iseth.

And because the *Axis* of the *Earth* A B, (as hath been said already) about which its *Diurnal Revolution* is performed, doth at present decline almost 23 Degrees from the Perpendicular 1, 6 of the *Ecliptick*, in which the *Earth* in a Years time performs his *Course* round the *Sun*; it so is, that the *Earth*, in various parts of its *Orb*, by objecting these two *Poles* of the inclined *Axis*, more or less, turned to or from the *Sun*, and exposing its several parts, sometimes for a longer, at other times for a shorter Space to the *Sun*, doth by this means produce the different *Seasons* of the *Year*, and the *Inequality* of *Days* and *Nights*. So that that part of the *Earth* which hath its *Axis* more inclin'd towards the *Sun*, enjoys *Summer*, as admitting the more direct *Rays* of the *Sun*, and consequently stronger and hotter: Whereas in that part which hath its *Axis* more turn'd away from the *Sun*, it is *Winter*, because it receives the *Rays* of the *Sun* more obliquely, and consequently more scatter'd and less agitated. And that part which continues longer turn'd toward the *Sun*, enjoys longer *Days*; as that which is for a less time illustrated by the *Sun*, has shorter *Days*.

XV.
There are
four Signs,
to which
when the
Earth ap-
proacheth,
she produ-
ceth the
different
Seasons of
the Year.

This will appear more manifest, by shewing how the *Seasons* come to be, and how it happens that with some *Inhabitants* of the *Earth* it is *Spring*, with others *Summer*, with others *Autumn*, and with others *Winter*. Let us place therefore 4 Points, *Libra* ♎, *Capricorn* ♐, *Aries* ♈, and *Cancer* ♋, as *Centers*, or 4 Equal *Circles*, that may represent the *Earth* to us, placed there at divers *Seasons*; the *Earth* with its *Center* running through the whole *Circumference* of *Libra*, *Capricorn*, *Aries* and *Cancer* in a years time, from *West* to *East*, according to the *Order* of the *Signs*.

XVI.
How Spring
comes to be

For it is manifest, that the *Earth* being placed in the *Point* of *Libra* ♎, at the same time that the *Sun* is in the opposite *Sign* of ♐, *Spring* time begins with us, who inhabitate the North parts of the *Earth*; because the North Pole of the *Earth* A, being constituted between its past greatest *Declination* from the *Sun*, and its future greatest *Inclination* to it, makes, that the *Sun-beams* falling upon our *Temperate Zone* 1, 2, reach it only obliquely; and therefore make the Air, yet thick and sluggish by reason of the *Winters Cold*, more temperate about this time of the *Year*. And forasmuch as both the *Poles* A B, about which the *Earth* is carried by its *Annual Revolution*, are constituted in the *Extream* parts of the *Hemisphere* of the *Earth*, that is illuminated by the *Sun*; by this means it comes to pass that we, and all other *Inhabitants* of the *Earth* have equal *Days* and *Night*.

XVII.
How we
come to
have Sum-
mer, and
those who
live in the
South part
Winter at
the same
time.

But when the *Earth*, in its *Annual Revolution*, comes nearer to *Capricorn* ♐, the North Pole A, doth further enter into the *Hemisphere*, illuminated by the *Sun*; whereas the Southern Pole B, is more withdrawn from it. By which means it comes to pass, that to those who live towards the North Pole A, the *Days* begin to increase, and the *Heat* to prevail; whereas those who live about the South Pole B, experience the contrary. But when the *Earth* is come quite to *Capricorn* ♐, viz. at the same time that the *Sun* appears in *Cancer* ♋, we enjoy *Summer*; because the North Pole A being at that time most inclined towards the *Sun*, it makes the *Sun-beams* to fall directly, and almost perpendicularly upon our *Temperate Region* 1, 2, and the

Cold Region 1, A; and therefore produceth the greatest *Heat*. But to them who live beyond the *Equator* 3, towards the South Pole B, *Winter* happens at the same time; because the *Antartick Pole* being at that time in his furthest *Declination* from the *Sun*, the *Beams* thereof reach it very obliquely and consequently impart but very weak *Light* to them. At the same time the *Longest Days* are with us, and the *Heat* increaseth; because the North Pole A continuing for a long time in that *Hemisphere* of the *Earth* which is illustrated by the *Sun*, makes us to enjoy the *longest Days* and *shortest Nights*. The contrary to which happens to the Southern *Inhabitants*, because the *Antartick Pole* B, is then entered into the *Darkened Hemisphere*; and therefore makes, that those who inhabit the *temperate Zone* 4, 5, and the *Cold* 5 B, are for many *Hours* overwhelm'd with *Darkness*, and enjoy the *Light* but a very little Space.

Afterwards, when the *Earth* having left *Capricorn* proceeds to *Aries* ♈, the North Pole A, doth more and more decline from the *Sun*, towards the *Hemisphere* of the *Earth* that is cover'd with *Darkness*; but the *Antartick* B, towards the illuminated *Hemisphere*, which causeth the *Days* to be shortned to us, that live North; whereas those that live South, begin to have their *Days* and *Heat* increased: Till at last the *Earth* being arriv'd at *Aries* ♈, both the *Poles* being in the *Extremes* of both the *Hemispheres*, viz. of that which is enlightened, and that which is *Darkened*, produce Equal *Days* and *Nights* to all the *Inhabitants* of the *Earth*.

XVIII.
How it
comes to
be Spring
with us,
and Au-
tumn with
those who
live to-
wards the
South
Pole.

Last of all, As the *Earth* continues his *Course* from the *Point* of *Aries* ♈, towards *Cancer* ♋, the *Artick Pole* A by degrees begins to enter the *Darkened Hemisphere*, and the *Antartick* or Southern Pole, the illuminated *Hemisphere*: By which means it comes to pass, that they who live beyond the *Equator* 3, begin to have longer *Days*; and they shorter, who live towards the North: Till the *Earth* being arriv'd at *Cancer* ♋, the North Pole becomes dipt 23 Degrees in the *darkened Hemisphere*, and thus makes *Winter* and the *shortest Day* to the Northern *Inhabitants*; whereas to those that dwell in the South, it makes *Summer* and the *longest Day*. Lastly, the *Earth* proceeds from the *Point* of *Cancer* ♋, to *Leo* ♌, and *Virgo* ♍; till that being arriv'd again at *Libra* ♎, it restores *Spring* to those of the North, and *Autumn* to those of the South.

XIX.
How it
comes to
be Winter
with us,
and with
the Inha-
bitants of
the South
Summer.

All the fore said *Seasons* of the *Year*, as to the length and shortness of the *Days* and *Nights*, in the continual process of *Years*, are much alike; because the *Diurnal* and *Annual Revolution* of the *Earth*, whence the *Vicissitudes* of *Days* and *Nights* do arise, are in all years much alike.

XX.
Why the
Seasons are
every year
alike.

However, because the two *Conversions* of the *Earth*, viz. the *Annual* and *Diurnal*, would be more commodiously performed, if they were done about *Parallel Axes*, the *Causes* that hinder this are by degrees changed; whereby it comes to pass, that in process of time this *Declination* of the *Ecliptick* from the *Equator* will grows less and less.

XXI.
How the
Poles of
the Equa-
tor and
Ecliptick
come to
approach
to one
another.

CHAP. VI.

Of the Zones and their Inhabitants, and of the Climats.

I.
There are
five Zones
in the
Earth;
and what
we are to
understand
by the word
Zone.

II.
The Torrid
Zone.

III.
The Temperate
Zones.

IV.
The Frigid
Zones.

V.
The Torrid
Zone is not
inhabitable,
as was
believed
by the
Ancients.

THe Ancients, to distinguish the Degrees of Heat and Cold on the Surface of the Earth, did divide it into 5 Zones, viz. into the Torrid Zone, 2 Temperate, and 2 Cold Zones. By the Name Zone they understood a space of the Earth, lying between the two Tropicks; or one of the Tropicks, and the next Polar Circle; or between either of the Polar Circles, and the Neighbouring Pole. So that the Zones are nothing else, but different Regions of the Earth differing in Temperature, according to the Suns Nearness, or Distance.

The Torrid Zone, is that Space which is comprehended between the Tropicks; the Northern part whereof reacheth 23 Degrees and an half from the Equator; and the other part, as far towards the South: So as that the whole Space contains 47 Degrees in Latitude; and is therefore called the Torrid Zone, because it is scorched by the perpendicular Beams of the Sun.

The Zones that are placed between the Tropicks and the Polar Circles, are called Temperate; the one of them being between the Tropick of Cancer and the Arctick Circle, which is 43 Degrees broad. And this is called the Temperate Zone towards the North. The other is call'd, the Temperate Zone towards the South, between the Tropick of Capricorn and the Antartick Circle, and hath as many Degrees in Latitude as the former.

The other two which are comprehended within the Polar Circles, are called Frigid or Cold: Whereof one is the Northern Frigid Zone, between the Arctick Circle and the North Pole; from which Circle to the Pole, are accounted 23 Degrees and an half. The Southern Frigid lies between the Antartick Circle and the South Pole, and is just as many Degrees in Latitude.

The Ancients believ'd the Torrid Zone to be Inhabitable; according to that of Ovid,

—of these, the Middle Zone,
Is scorched with Heat, inhabited by none.

But Experience hath now better inform'd us; for the Spaniards, Portuguese, Hollanders, and also the English, who have Sailed round the World, as they call it, have found the Torrid Zone not to be scorched with intolerable Heat, but Temperate enough, and water'd with plentiful Showers, and with frequent Rivers and Springs, abounding also with all manner of Fruit and Corn, and affording a pleasant and delightful Abode to Animals and Men, so as that People of several Nations come to inhabit there. This appears also consonant to Reason; because the Length of the Nights, which are equal to the Days, in those Regions, doth greatly allay the heat of the Air. Neither are there wanting in this Space many Lakes, Pools, and other moist places, whence copious Vapours are raised, which afterwards coming down in Rain, do allay and temper the heat of the Sun. For tho' the Rains that fall there be but small, yet they are so frequent, as sometimes to continue for some Months together, greatly favouring the growth of Plants, and conducing to the refresh-

ment of Men, and other Living Creatures. Which inclines me to be of Polybius his Opinion, who asserts that part of the Earth under the Equator to be more Temperate, than that which is under the Tropicks; because when the Sun is about the Equator, he presently runs over the Vertical Point; but when at the Tropicks, he continues Vertical for several Days.

There is a difference amongst the Inhabitants of the Torrid Zone: For some of them live under the Equator, others under the Tropicks, and others again between the Equator and the Tropicks. The Sun toucheth the Zenith or Vertical Point of all these, once or twice every Year. They who live under the Equator, in the first place, have a Right Sphere: Secondly, They alone enjoy a Perpetual Equinox: Thirdly, They alone have the view of both Poles: Fourthly, To them alone all the fix'd Stars Rise and Set: Fifthly, They have two Summers and two Winters: Sixthly, The Sun passeth their Zenith twice in a Year. Those who live under the Tropicks do first experience two Meridional Shadows, in a Years time: Secondly, They have but one Summer, and one Winter: And lastly, The Sun reacheth their Zenith once in a Year. They who live betwixt the Equator and the Tropicks, have 3 South Shadows in a Year; in the next place they have 2 Summers and 2 Winters, especially if they be more remote from the Tropicks: Thirdly, The Sun passeth their Zenith twice in a Year.

The Inhabitants of the Temperate Zones, in the first place, have one South shadow in a whole year: Secondly, They have two Solstices: Thirdly, They have one Summer and one Winter in a year: Fourthly, The Sun never reacheth their Vertical Point: Fifthly, They have 2 Equinoxes every year, as all those have that have an oblique Sphere, or that dwell betwixt the Equator and the Poles.

The Inhabitants of the Frigid or Cold Zones, are of 3 sorts: For they either live under the Polar Circles, or under the Poles themselves; or betwixt the Circles and the Poles. They who live under the Polar Circles, do alone enjoy a Day of 24 Hours long; and all other things which happen to the Inhabitants of the Temperate Zones, happen also to them. They who live under the Poles, have a Day of 6 Months, to which succeeds a Night of the same length. They have never any Equinox, and to them alone no fix'd Stars ever Rise or Set. But they who live betwixt the Poles and the Polar Circles, their longest Day in the Summer is above 24 Hours. They do not see the Sun, whilst he is in the Tropick of Capricorn. Other things they have common with those that live under the Polar Circles.

Another Distinction of the Inhabitants of the Earth is taken from the opposite situation of their Habitation; and this Difference is Threefold, being distinguish'd into Periaci, Antæci, and Antipodes.

They are call'd Periaci, who live under the same Parallel, and the same Meridian, but yet under the opposite Points thereof. Such are those who live in the places marked 7 and 8, and 3 and 6. Now all these have the same Summer and Winter, and much the same Temperature of the Air, and the same Length and Shortness of Days

VI.
The Inhabitants of the Torrid Zone, are in a threefold difference.

VII.
The Inhabitants of the Temperate Zones.

VIII.
The Inhabitants of the Frigid Zones.

IX.
The Difference of the Inhabitants of the Earth, with respect to their situation.

X.
Periaci.
Fig. 4.

and Nights; but have their Day and Night at a contrary time to one another: Except they be placed within the *Frigid Zone*, because then it may so happen, that they have the same Day and Night.

XI.
Antæci.

Antæci are those that live under *Parallels*, that are equally distant from the *Aequator*, and under the same *Meridian*, in the same *Longitude*. Such are those who dwell in the *Points* 3 and 7, and in 6 and 8. They have the same *Noon* and *Midnight*; but have their *Summer* and *Winter* at opposite times: So as that the longest Day of one of them, is the shortest Day of the other. The *Antæci* between the *Tropicks* may have the same *Winter*, but never *Summer* at the same time.

XII.
Antipodes.

Antipodes, or *Antichtones*, are those who live under *Parallels* or *Points* distant the same *Latitude* on either side of the *Aequator*; or under the *Aequator* it self, but yet in opposite *Points* of the same *Meridian*: Or more briefly, as *Cicero* has it, *Antipodes* are those whose steps are opposite to each other. And such are they who live in 1 and 2, 5 and 4, 6 and 7. The *Antipodes* without the *Aequator*, 5 and 4, have all things opposite. Those at 5 and 4, have *Night* and *Day* quite contrary: And all the rest have also their *Summer* and *Winter* at contrary times. There is no *Point* assignable on the *Surface* of the *Earth*, to which an *Antipodal Point* doth not answer; and this is nothing else, but the other *Extremity* of the *Diameter* from the foresaid *Point*, passing through the *Center* of the *Earth*. Whence it is, that these great Varieties must needs happen.

XIII.
The Opinion of the Ancients concerning the Antipodes.

Those who are our *Antipodes*, live towards the *South Pole*, and are yet undiscover'd what kind of *People* they are; but the *Antipodes* of other *Nations* are known. For though some Great Men of Old did deny *Antipodes*, as supposing that if any such were, they must hang in the *Air*, and have their *Heels* higher than their *Heads*; yet these are worthily derided by *Lactantius*, *Lib. 4. cap. 14. de Falsa Sapientia*; forasmuch as the *Inhabitants* of the *Earth*, in what part soever they live, tread upon the *Earth* with their *Feet*, which every one may easily understand that considers the *Earth* to be *Round*.

XIV.
Why the Surface of the Earth was divided into Climats.

But because the *Distinction* of *Zones* did not seem sufficient to the *Ancients*, to specify all the diversity of the *Situations* of *Regions* about the *Aequator*, they thought convenient to add many *Parallels*, by which, as by so many lesser *Zones* they divided the *Earth*, and called them *Climats*, as being so many *Inclinations* or *Deflexions* from a *Right Sphere*. Yet there is this difference betwixt the *Parallels* and *Climats*; that the *Parallels* are only of one Quarter of an Hour, but the *Climats* of Half an Hour. So that in whatsoever place of the *Earth* the *Solstitial Day* is one Quarter of an Hour longer than 12 Hours, that place is under the first *Parallel*. But if the Excess reach to Half an hour, that place is situate under the second *Parallel*; or, which is the same, under the first *Climat*. For by *Climats* the *Ancients* understood nothing else, but large Spaces of the *Earth*, or *Zones*, between two *Circles Parallel* to the *Aequator*, equal in *Latitude*, and passing through every 10th Degree of the *Meridian*. These are 18 in all, 9 whereof are called *Northern*, and 9 *Southern*.

The first *Climat*, from the *Aequator* towards the North, hath its beginning where the Longest Day is of 12 Hours, and its *Latitude* or distance from the *Aequator* is 10 Degrees; towards the further part of which, the Longest Day is 12 Hours, 35 Minutes. It is commonly called *Æthiopicum*, from the Country of *Æthiopia*, as passing over the City *Meroe*. For the Custom of the *Ancients* was, to put the Name of some Famous place contained in it upon the several *Climats*.

The second *Climat* is that, where the *Latitude* is of 20 Degrees, and the Longest day of 13 hours and 12 minutes, and is called *Arabicum*, from *Arabia Felix*, through which it passeth.

The third is that where the *Latitude* is of 30 Degrees, and the Longest day of 13 hours and 56 minutes: And took the Name *Ægyptiacum* from *Alexandria*, the Metropolis of *Ægypt*, through which it passeth.

The fourth *Climat* is that, where the *Latitude* is of 40 Degrees, and the Longest day of 14 hours and 51 minutes. It is called *Syriacum*, because it passeth through *Rhodes* in *Syria*.

The fifth is, where the *Latitude* is of 50 Degrees, and the Longest day of 16 hours and 9 minutes; and it was call'd *Italicum*, or *Gallicum*; because it passeth through *Rome* and *Paris*, where the Longest day is of 16 Hours.

The sixth is where the *Latitude* is of 60 Degrees, and the Longest day of 18 hours and 30 minutes; and this is called *Britannicum*, or *Germanicum*.

The seventh is, where the *Latitude* is of 70 Degrees, and the Longest day of 65 Days; and is commonly call'd *Suecicum*.

The eighth is, where the *Latitude* is of 80 Degrees, and the Longest day of an 134 Days; and is called *Glaciale Boreum*.

Lastly, The ninth is that Space which is extended to the *Northern Pole*, where the Longest day is of Half a year, or of 183 Days, and is called *Polare Boreum*.

The first of the *Southern Climats* begins at the *Aequator*, and ends in the 10th Degree, where the Longest day is of 12 hours, 35 minutes. It takes its name of *Brasilianum*, from the Country of *Brazile*.

The second is, where the *Latitude* is of 20 Degrees, and the Longest day of 13 hours and 12 minutes: And is called *Peruanum*, from the Country of *Peru*.

The third is, where the *Latitude* is of 30 Degrees, and the Longest day of 13 hours and 56 minutes; and is called *Paraguaticum*.

The fourth is called *Chiliacum*, from the Country of *Chili*, which is extended 40 Degrees towards the South; where the Longest day is of 14 hours and 51 minutes.

The fifth is, where the *Latitude* extends to 50 Degrees, and the Longest day is of 16 hours 9 minutes. It is called *Sylvestre*, because it is inhabited by *Savages* and *Wild People*.

The sixth is call'd *Magellanicum*, where the Longest day is of 18 hours and 30 minutes, and reacheth to 60 Degrees.

The seventh is of 70 Degrees, and is call'd *Incognitum, Unknown*; where the Longest day is of 65 Days.

XV.
The first Northern Climat, is that which is call'd Æthiopicum.

XVI.
The second, Arabicum.

XVII.
The third, Ægyptiacum.

XVIII.
The fourth, Syriacum.

XIX.
The fifth, Italicum.

XX.
The sixth, Britannicum.

XXI.
The seventh, Suecicum.

XXII.
The eighth, Glaciale Boreum.

XXIII.
The ninth, Polare Boreum.

XXIV.
The first of the Southern Climats, is called Brasilianum.

XXV.
The second, Peruanum.

XXVI.
The third, Paraguaticum.

XXVII.
The fourth, Chiliacum.

XXVIII.
The fifth, Sylvestre.

XXIX.
The sixth, Magellanicum.

XXX.
The seventh, Incognitum.

The

XXXI.
The eighth,
Glaciale
Austrinum.

XXXII.
The ninth,
Polare

Austrinum.
XXXIII.
Of Old
there were
only seven
Climats,
whereas
now there
are eight-
teen.

The eighth is that, where the Latitude is of 80 Degrees and the Longest day makes 134 of our Days; and is called *Austrinum Glaciale*.

The ninth and last is extended to 90 Degrees, where the Longest day is of 6 Months, and is called *Polare Austrinum*.

Formerly there were only 7 Climes, because they contained all the Countries that were then known: But the Earth being more known and discover'd, is now distinguish'd into 18 Climates, which Astronomers call by another name, *Elevations of the Pole*; and Geographers, the *Latitude of Places*, or their *Distances from the Equator*.

CHAP. VII.

Of those things which are generated in the Earth; and first of Fountains.

I.
Fountains
and Rivers
have their
Rise from
the Sea.

Forasmuch as Fountains break forth on the Surface of the Earth, and proceed from its bowels, we must enquire in the first place, what is the Original of Fountains, and from what Principle they are derived. And this we find can be nothing else but the Sea: For seeing that many Fountains flow continually, and that the Rivers which are made by them, do without ceasing continue their Course towards the Sea, without ever increasing the same, according to that of the Wise King in the 1st of Ecclesiastes; *All the Rivers run into the Sea, yet the Sea is not full; unto the place from whence the Rivers come, thither they return to flow again*. And accordingly we may easily gather, that the Original of Fountains is from this, That the Sea-Water being driven into the Bowels of the Earth, is led up to the Surface thereof; where breaking forth, it at last, after various Turnings and windings, returns to the Sea.

II.
They return
to the Sea,
from
whence
they came.

And indeed, forasmuch as the Earth contains many Clefts, by which, as by so many Channels, the Water may be carried from one place to another; there is no reason to oppose, but that Water may come from the Sea, to the bottoms of Mountains; and that the same which break forth in Springs from those Mountains, may after various windings run again into the Sea. Much after the same manner, as we find that in Living Creatures the Blood is carried from the Left Ventricle of the Heart, through the Aorta into the Arteries and Veins, and after having finish'd its Circulation, returns to the Vena Cava, and from thence to the Heart, from whence it came forth at first.

III.
How the
Water
riseth from
the Sea to
the Tops
of Moun-
tains.

But forasmuch as the Surface of the Earth is not even, some part of it being stretch'd out into Plains and Levels, and others rising into Mountains, which do far exceed in height the Surface of the Ocean; we are to enquire, by what means the Water becomes rais'd from the Depths of the Earth, to the Tops of the highest Mountains; as also how the Sea-Water becomes deprived of all its Saltiness, when it breaks forth into Springs and Fountains whose Waters are fresh.

IV.
Not by the
Suction or
Attraction
of the
Earth.

As to the first of these, some are of Opinion that this is performed by the Earth, to which they attribute a Virtue of sucking and attracting the Water to the tops of the Mountains: After the same manner as Bread being dip'd in Wine, doth

suck and draw up the Wine into it self; or as a Sponge, sucks-up Water. But this way of explaining this Difficulty is not Rational, since Sucking presupposeth a sensible Motion in the Body that sucks; for I cannot suck without some dilatation and swelling of my Body: Neither can it be suppos'd that the Earth can perform any such action. And as to the Instance of Bread, or a Sponge dip'd in Water, nothing can be inferr'd thence to prove, that the Earth sucks up the Water to the tops of the Mountains; seeing that it is but a small quantity of Water that is suck'd-in by the Spongy Body; and that that which is attracted by it, doth never run out from it. And so likewise may that part of the Earth, which lies next to the Spring, be moistned and soak'd through with the Water of it; but this will never make the Water spring or break forth from thence.

Others suppose, that the Sea-Water is rais'd to the highest parts of the Earth, by means of that pressure whereby the surface and upper-part of the Sea-Water presseth that which is at the Bottom, and forceth it up the passages of the Earth, till having at last found an Out-let, it breaks forth on the Surface thereof. But neither can this Opinion be admitted; for tho' the Water at the bottom of the Sea, be driven into the Cavities and open Passages of the Earth, by the weight of the Water that lies upon it; yet can it not by this means be rais'd higher than the Surface of the Sea. Besides, if the Water by some Channels, or wide and open Passages, should be conveyed by one continued Channel, from the Sea to the Surface of the Earth, then it would not be fresh, but salt; because the Salt easily gets through those places, where the Water in any quantity can pass; and so all Springs would be as salt, as the Sea it self.

V.
Nor by the
pressure of
the Sea-
Water.

We suppose therefore, that the Water in those Holes and Caves, whither it is driven by its weight, is resolv'd into Vapours by the Subterranean heat; and that this Heat, by those Passages which it every where meets with, mounts it upwards, and raises it to the tops of the Mountains. To which may be added, that the Pores through which the Vapours tend upwards, are continued open towards the very tops of the Mountains, and that they more easily mount up through the said Pores, because they are supported by the Particles of Earth, than through the Air, whose fluid and soft particles, cannot so uphold them and assist their Elevation. Now that there are such Subterraneous Fires, that turn the Water into Vapours, is evident from those Fire-Vomiting-Mountains, *Hecla*, *Vesuvius*, *Aetna*, and others of the same nature. And tho' such Fires do not break forth from all parts of the Earth; yet it is probable that they communicate their Heat far and near, by means of hollow Passages in the Earth, in the same manner as the inborn Heat is dispersed through the Guts and other parts of the Body.

VI.
The Sea-
Water
being turn'd
into
Vapours,
mounts up-
wards.

But when the Vapours are thus mounted up, and are come near the surface of the Earth, they then become condensed by meeting with the Cold parts of the Earth; and by this means being unable to mount higher, they cling together, and are turn'd to drops of Water: And since in this state they are not able to return back by the same Passages, or Pores, because of their Narrowness, they are carried downwards by their own weight, where

VII.
Condensed
Vapours
through the
Mountains
with
Water.

where many of them being united together make a *Subterraneous Rivulet*; and many of these *Rivulets* gather'd together make a greater, which breaking forth out of the *Earth*, constitutes a *Living Fountain* or *Spring*. An Example whereof we have in *Chymical Distillations*; where, by the means of *Fire*, many *Vapours* are driven up the *Alembick* from moist *Bodies*, which are condensed in the cool Head of the *Still*, and being united into *Drops*, run down the *Neb* thereof.

VIII.
What
Springs or
Fountains
are.

So that *Springs* are nothing else, but *Sea-Water*, which being by its own weight driven to the bottom of *Mountains*, is there changed into *Vapours* by the inward heat of the *Earth*, and again condensed into *Water* by the Coldness of the *Air*, or that of the tops of *Mountains*; whence these run down, according to the declining of the *Passages* that convey them, to the open place they have made for themselves on the side, or at the foot of the *Mountains*.

IX.
Why some
Springs are
dried up in
Summer.

Some, it may be, will object: If it be true that *Springs* have their Rise from the *Sea*, whose *Waters* being resolv'd into *Vapours*, by means of heat are again changed into *Water*; how comes it to pass that some *Springs* are altogether dried up in *Summer* time, and do quite vanish by extream heat, since it cannot be question'd, but at that time many *Vapours* mount up from *Subterraneous* places, and that likewise there is Cold enough about the surface of the *Earth* to condense them.

X.
Answer.

I Answer, That these *Springs* which are subject to dry up in *Summer*, do for the most part owe their Original to *Rain* and *Snow*, which running through the *Clefts* of *Rocks*, do afterwards insinuate themselves through the *Pores* of the *Earth*, and drop down into some hollow places, and being there resolv'd into *Vapours*, by the Heat lodg'd in the *Bowels* of the *Earth*, meet with some proper place, by the Coldness whereof they become condensed, and so discharge themselves through some open passages on the surface of the *Earth*. Hence it is, that after long continued *Rains* we see many *New Springs* arise, which afterwards by degrees vanish, except more *Showers* succeed and fill those hollow places of the *Earth* from whence they proceeded, and supply Matter for a new breaking forth of *Water*.

XI.
Of the
various
kinds of
Fountains.

Whence we may distinguish *Fountains* into several kinds, according to their different ways of *Flowing*, *Falling*, or *Duration*; and so *Springs* or *Fountains*, are either *Temporal* or *Perpetual*: *Temporal*, are those that do not run continually: *Perpetual* are such as *spring* without ceasing. Which are again divided into *clear* and *pure Fountains*, falling down by drops, or gushing out with a *stream*; or *mixed*, being such as are impregnated with *Salt*, *Sulphur*, *Bitumen*, or *Few Lime*, and the like.

XII.
How Wells
come to be
generated
in the
Bowels of
the Earth.

Wells are furnish'd with *Water* much after the same manner as *Springs* are: For after that the *Vapours* of *Water* have been raised to the surface of the *Earth*, they are by the Coldness thereof changed into *Water*; which afterwards wandering under *Plains* and *Mountains*, without being able to mount up to the surface of the *Earth*, are there turn'd into *Wells*. Now the reason why *Well-water* doth not ascend higher, is, because *Water* cannot mount up above the place of its first Rise, for being come up to that pitch, it is equally

pois'd, and so can rise no higher. Another Reason also may be, because *Wells*, for the most part borrow their *Waters* from *Rivers*, *Lakes*, and *Pools*, not far off: Or if they receive their *Waters* from the *Sea*, the said *Waters* being drained through the *Earth*, run together into one and the same place.

Hence it is that *Springs* and *Wells*, tho' they proceed from the *Sea*, yet their *Waters* are fresh, whereas the *Sea-water* is salt. The Reason whereof is this, because the *Sea-water*, consisting of fresh and salt *Particles*, whereof the fresh only are turned into *Vapours*, and carried upwards, leaving the salt particles behind, it is plain that their *Water* must be fresh. For the salt *Particles*, being stiff and inflexible, can neither be changed into *Vapours*, nor pass through the winding and bending pores of the *Earth*. The *Water* therefore of *Wells* and *Fountains* is fresh, because the *Sea water* being drain'd through much *Sand* or *Earth*, is depriv'd of its stiff saline *Particles*, and so becomes fresh.

If any Man enquire how it comes to pass, since only fresh *Water* is drained through the *Earth*, that notwithstanding much *Salt* should be found in some *Wells*, at a great distance from the *Sea*.

I Answer, That this may happen, because the *Passages* of the *Earth* in some places are more wide and open, through which the *Sea-water* passing freely, may reach those *Wells*, without leaving its saline particles behind it: Or, because the surface of the *Sea* may lye level with the bottom of those *Wells*; or likewise, because where the ways are wide and open, the particles of *Salt* are carried upwards by the particles of *Fresh water*. Of which this is a confirmation, because in some *Mountains* are found vast lumps of *Salt* grown together like great *Stones*: For the *Sea-water* being got up thither, whilst the particles of *Fresh-water* mount still higher, the *Salt* is left alone in those *Cavities* it meets with there, and fills them up.

Some *Fountains* are famous for their *ebbing* and *flowing*, like the *Sea*; yet not all in the same manner. For there is one at *Cadix*, and another at *Bordeaux*, that imitate the motion of the *Sea*, and *ebb* and *flow* at the same time with it. There is another in *Spain* which ebbs when it is flood at *Sea*, and flows when there is an *Ebb-tide* at *Sea*.

The Cause of this *ebbing* and *flowing* in *Fountains* cannot be attributed to any thing, but to the *Sea-tide*; by means whereof the *Sea* entering into some *Subterranean passages*, drives up the *Water* as high as it self riseth. But the Reason why these *Springs* variously imitate the *Sea-tide*, is to be deduc'd from the difference of the passages through which the *Water* is convey'd: For if these *Channels* be strait without windings, or if the distance from the *Sea* be small, the *Fountain* flows at the same time with the *Sea*, and falls again when the *Sea* ebbs. But if the *Water* be convey'd to the *Cavities* of *Fountains*, through many crooked and winding passages, it may so happen that the *Fountain* may not swell when the *Sea* flows, nor fall when it ebbs; but quite contrary may swell when it ebbs, and sink when the *Sea* flows; because the *Water* having so many winding passages to go through, much time is thereby lost, so that by that time the *water* of the *Fountains* begins to swell, the *Sea* begins to *ebb*.

D d d

CHAP.

XIII.
Why Spring
and Well-
water is
fresh.

XIV.
How it
comes to
pass, that
Salt water
is found
in some
Wells.

XV.
The An-
swer.

XVI.
Of the
Flow

XVII.
The Cause
of the
ebbing and
flowing
Fountains,
is the Sea.

CHAP. VIII.

Of Metals and Minerals.

I.
What Me-
tals are.

Metals are Bodies dug out of the Earth, Heavy, Hard, and Fusible by Fire, hid in the inward part of the Earth, and there generated by the heat of the Sun, and subterraneous Fires. Such as are Gold, Silver, Copper, Iron, Tin, and Lead.

II.
Of what
Parts the
Metals are
compound-
ed.

The Particles which compose Metals, are Salt, Oil, and Earth; which being mingled together, and meeting in the long and branch-like Pores of the inward parts of the Earth, are in the same so straitly link'd together, that Art hath not as yet found out any means whereby to separate them.

III.
Which be
the pure
Metals.

Some of these are called Pure Metals, others Impure: Pure Metals are those, which compar'd with others, have been excocted or digested to a greater degree of fineness and perfection, by means of the Solar and subterraneous Heat; such as are Gold and Silver. Gold is the most heavy and most perfect of all Metals, very ductil, consisting of parts of equal Fineness and Heaviness, and being more heavy than the particles of Fire, cannot be carried away by them: Which is the Reason why Gold, when it is melted, loseth nothing of its weight, as having no Drofs, which by the Action of the Fire might be separated from it. Silver is a Metal in Fineness and Perfection inferiour to Gold, heavy and solid, less ductil than Gold, and which being melted in the Fire, loseth something of its weight; more especially that which by the agitation of the Fire is turned to Drofs.

IV.
Which the
Impure.

Impure Metals, are those whose Principles are not so mature and refin'd, nor so fix'd and pure. Some of these, because of their impure Earthy substance, are made Red-hot before they can be melted; as Copper and Iron: Whereas others of them, because of their abounding Moisture, are melted before they become Red-hot; as Tin and Lead.

V.
What Prin-
ciples of
the Chy-
mists exa-
mined.

To the end that the Nature, not only of Metals, but of Minerals also, may be the more clearly and distinctly known, it will be fitting that we know before-hand, what we are to understand by the Active Principles of the Chymists; and what the Philosophers mean by Salt, Sulphur, and Mercury.

VI.
What we
are to
understand
by the
word Salt.

By the Name of SALT, we understand a sharp Juice, consisting of slender and stiff particles, which being intercepted in the Pores of the inward part of the Earth, are beaten or forged into little Swords: For as a round Rod of Red-hot Iron, is by the frequent strokes of Hammers beaten into a longish thin Plate; so those particles, by being dash'd and rubbing against the hard Sides of the Pores of the Earth, are form'd into such Figures. Wherefore Salt is nothing else, but a sharp Juice, consisting of slender, stiff and sharp Particles. Which, if it be volatil and very bitter, is called Salt Armoniack; if it be more fat and inflammable, growing to Walls and Rocks, 'tis called Nitre and Saltpeter; if it be found in Mines and Mineral-waters, Allom; if it be joyn'd with a Metallick matter, and a most sharp and subtil Mercurial Juice, 'tis called Vitriol.

By SULPHUR we understand, the very soft and minute Branchy particles of Fat and Oily matter. And that such particles abound in Brimstone, we can demonstrate by this that it is very inflammable; for it is evident, that soft and thin particles, are the first of all others put in motion, and snatch'd away by the Fire. Sulphur therefore is a Mineral Juice, consisting of the most soft and minute Branch-like particles of Fat and Oleaginous Matter, easily inflammable, and generated in the Caverns of the Earth.

By the Name of MERCURY we understand Quicksilver, or an opaque and ponderous Liquor, consisting of thick, slippery and smooth particles; whose Nature shall be explained hereafter.

Metals are commonly reduced to six species, as was before mention'd, viz. Gold, Silver, Copper, Iron, Tin and Lead. To which some joyn Mercury or Quicksilver, which tho' it be liquid in its Natural state, and Proteus-like changeth it self into all forms; yet may it be made solid, and that several ways; as when it is held over the Fumes of Molten-Lead, &c. The Astrologers seem to favour this Opinion, viz. That Quicksilver is a Metal, who, as they appropriate Gold to the Sun; Silver to the Moon; Iron to Mars; Copper to Venus; Tin to Jupiter; and Lead to Saturn; so they attribute Quicksilver to Mercury, and do own its Virtue to be derived from the Influences of that Planet.

To the end we may more clearly discover the Original of Metals, it will be of use to suppose, that in the Inward part of the Earth there are certain fluid Bodies, whose particles do not stick so close together, but that they may be easily dissolved: Such as are some Earthy Juices, which being generated in the deepest Bowels of the Earth, and consisting of the thickest particles of the upper part thereof, do fall down thicker by the force of the Globuli of the second Element, which by pressing them makes them heavy, and by passing through the Pores, wherewith they abound, somewhat agitates and makes them less, and so reduceth them to two kinds of Figures. For the Particles whose Matter is more solid, as those of Salt are, being intercepted, and, as it were, hammer'd in those Pores, of round and stiff, are made plain and flexible: Much after the same manner, as we have said, that a Rod of Red-hot Iron is hammer'd into a thin longish plate. And forasmuch as these particles, being agitated by the force of Heat, do this way and that way creep through these pores, by dashing and rubbing against their hard Sides, they become sharp like so many little Swords, which then constitute sharp, sourish, and corroding Juices. But the more soft particles, as are those of Fresh-water, and the like, being in the said pores wholly crush'd and bruised, are reduced to so great a thinness, that by the Motion of the first Element, they are divided into many very small and extremely flexible little Boughs, which lying upon one another, are moved by a slow and creeping motion.

Forasmuch therefore as Metals are solid and heavy Bodies, it is evident that they cannot consist of the outward Crust of the Earth, which is softer than the other parts. For tho' the uppermost part of the Earth consists of Ramous or Branchy parts, which

VII.
What Sul-
phur is.

VIII.
What Mer-
cury is.

IX.
The number
of Metals.

X.
The various
Juices
that are
in the
Bowels of
the Earth.

XI.
Metals are
formed in
the inward
parts of
the Earth.

which are firmly joyn'd together; yet because there are many Intervals between them, which may be taken up by the *Air*, or other *Bodies*, and by their agitation are an obstacle to Solidity, which is the Property of *Metalline Particles*, it is necessary that they should be generated in the more inward parts of the *Earth*, which are more close, hard and compact. So that it seems probable that these *Metals* are hid, and cannot be reached or come to, by reason of the Depth of the *Earth*, and the store of *Water* that is about them, which those that go to search for them cannot fail to meet with.

XII.
How the
Particles
of Metals
are con-
veyed to
the out-
ward part
of the
Earth.

But seeing, that besides the *Vapours* which exhale from the *Waters* that lye hid under the *Earth*, there are also many sharp *Spirits*, and oily *Exhalations*; and likewise *Vapours* of *Quicksilver*, which can carry along with them, from the inward part of the *Earth*, the particles of other *Metals*, and with them ascend to the outside of the *Earth*; by this means these *Metalline Particles* being brought to the surface of the *Earth*, do there stop between the *Sand*, and constitute *Veins* of several *Metals*. For it is probable, that the Reason why any *Metals* come within our reach is, because the foresaid sharp *Juices* flowing through the passages of the inward parts of the *Earth*, do separate some of its particles from their fellows, which being wrapt up in some oily Matter, are afterwards easily carried upwards by *Quicksilver* rarified by *Heat*, where they constitute several *Metals*, according to the diversity of their magnitudes and figures.

XIII.
The distin-
ction and
diversity
of Metals,
depends on
the differ-
ence of
their Parts.

For nothing else is required to the Distinction of *Metals*, than the changing of their parts, or a different ranging of them: Because *Bodily things*, whose parts are of the same bigness, and alike ranged, are to be accounted the very same things; their distinction only proceeding from the various contexture of their Parts, as when by the accession of new Parts others are thrust out of their places, or they become otherwise ranged. And thus those particles that have long and round, as also smooth and slippery Figures, which because of their weight lye one above another, and are moved only by the Matter of the First Element, that fills up the Spaces between them, do constitute *Quicksilver*. For this is nothing else, but a very heavy and opaque Liquor, consisting of such thick Particles as are long, and round like a Pillar, and very smooth; which tho' by reason of their weight they lye one upon the top of another, yet are easily moved by the *Ethereal Matter* that fills their Pores. And so likewise those Parts which are so firm and fix'd, as that they cannot be changed by any Fire, or consum'd by any acid *Spirits*, constitute *Gold*. Thick and Branchy Particles, whose surfaces lye close together, and whose Pores are only penetrated with the striate Matter, make *Iron*. And so for the rest of the *Metals*, which derive their distinction from the different magnitude and figure of their Parts.

XIV.
Transmuta-
tion of
some Me-
tals is
possible.

For this Reason some have believed the Transmutation of *Metals* to be possible, since it is notorious that *Iron* may easily be changed into *Copper*: For if *Iron* be cast into *Copperas* or *Vitriolick Water*, its outside is thereby turned Red, which Red powder being frequently scrap'd from it, and melted down, becomes true *Copper*. The same Transmutation is also effected by some Foun-

tains; as by that which *AGRICOLA* mentions, near *Smolnitz*, the *Water* whereof being derived into three Channels rang'd in order, in which pieces of *Iron* are laid, they are thereby changed into *Copper*; and the small scales of *Iron* are so corroded by this *Water*, as to become like *Clay* or *Dint*: All which afterwards being melted down, becomes pure and good *Copper*. It is manifest also that *Quicksilver* may be chang'd into another *Metal*. For if after you have reduc'd *Lead*, or *Litbarge*, to *Ashes*, you pour the *Flegm* of *Vinegar* upon it, and afterwards pour some drops of this *Vinegar* upon *Quicksilver* dissolv'd in strong *Water*, it will presently be precipitated to the bottom of the Vessel in the form of a Powder, which being melted down becomes *Lead*.

But the Question is, Whether Imperfect *Metal*, by Example *Quicksilver*, can be turn'd into *Gold*? This the *Chymists* confidently assert, and take for their Vouchers, *RAYMUND LULLY* and *ARNOLDUS de Villa Nova*; who, they tell us could do as much. But I take all this to be no more than *Lies* and *Stories*: Or if ever they did make *Gold*, that this Effect was not to be attributed to their Art, but to meer Chance. And indeed it is a thing as unlikely, as if a *Man* having broke his *Hour-Glass*, should so dexterously throw the Sands of it upon a *Table*, that the grains of it should be ranged into the figures of such Letters as should make up some Verses of *Ovid's Fastorum*. For since we are ignorant of the precise bigness and figure of those Particles that enter the Composition of *Gold*; as well as of the way of knitting them together, so as to make one Body of them; we may well conclude, that to make *Gold* is a thing morally impossible.

XV.
It is mo-
rally im-
possible to
make
Gold.

It is a Property of *Metals* to be Ductil, and more especially of *Gold*, a small quantity whereof may be beaten or drawn out into a vast extent. For out of one Broad piece of *Gold*, a vast number of Leaves may be beaten, 5 or 6 whereof are sufficient to cover a piece of *Silver*, of a Cylindrical Figure; which being drawn into a fine Thred, the *Gold* is coextended with it, there being no part of the *Silver-thred* to be seen which is not gilt. The reason of this Ductility in *Metals* is, because the particles of *Metals* are of a Longish figure, and are so disposed, that they lye upon one another according to their whole surface; which makes, that when they are prest under the Hammer, or in Drawing, they fall down sideling, and joyn'd side to side without any separation. Thus it comes to pass, that *Metals* under the Hammer, may be extended into length and breadth, still retaining the firm cohesion of their parts; and the same is the Cause of their ductility into Threds.

XVI.
Ductility
is a Pro-
perty of
Metals.

Metals are subject to Corruption by *Rust*, and more especially *Iron*. Which is an Argument, that its particles are not more solid than those of other *Metals*, tho' they be Thicker; but that it abounds with Pores. And because these Pores after Infusion grow less, therefore it is that *Steel* is not so easily penetrated by other Bodies, as *Iron*, and consequently, less subject to *Rust*. Now *Rust* is nothing else, but a perturbation of the Parts of *Metals*, caused by the Exhalations of a greatly agitated Sulphureous Liquor, the particles whereof thrust themselves into the Pores of *Metals*, and stop the Orifices of them.

XVII.
Metals are
subject to
Rust.

The

XVIII.
The Sun is
the Efficient
Cause
of Metals.

The Efficient Cause of all *Metals* is the *Sun*, whose *heat* pierceth through all the *Passages* and *Pores* of the *Earth*. For tho' the *Action* of *Light* be nothing else, but a kind of *Pression*, whereby the *Sun* pusheth the *subtil Matter* to *Right Lines*, that reach from his *Body* to the *Earth*; yet the *Terrestrial particles* being agitated by his *heat*, do continue in their *motion*, except some intervening Cause do chance to hinder them. Hence it is we perceive, that the *Heat* which the *Light* hath left upon the *surface* of the *Earth*, doth continue for some time; so that it is no wonder, if from thence by degrees it proceeds to the *Bowels* of the *Earth*, because the *Terrestrial parts* that are struck by the *Sun-beams*, do move those that lye next to them, and they again their *Neighbours*, till the *Heat* at last be derived to the most *Inmost* parts of the *Earth*. After the same manner as a mans *Head* cover'd with a *Hat*, tho' it be not enlightened by the *Sun*, yet is sensible of its *heat*, even after that the *Sun-beams* do no more beat upon it. And thus much shall be sufficient to have spoken of the *Nature* of *Metals*, their *Original* and *Affections*; we proceed now to the *Minerals*.

XIX.
What Minerals
are.

MINERALS, are *Bodies* made up of *Salt*, *Sulphur* and *Mercury*, mingled in a certain proportion with *Aqueous* and *Terrestrial particles*, and excocted or brought to perfection by means of *Subterraneous fires*, or the *Sun's heat*, and digg'd out of the *Mines* of the *Earth*. Wherefore also they are called *Fossils*.

XX.
How many
sorts of
Minerals
there are.

There are Three kinds of *Minerals*: 1. *Mineral*, or *Coagulated Juices*: 2. *Mineral Earths*: 3. *Stones*.

XXI.
Mineral
Juices.

Coagulated Juices are *Mineral Bodies*, compounded of sharp and oleaginous *Juices*, mingled with a more gross *Earthly Matter*, endued with a strong taste or smell, and easily soluble in *Water* or *Oil*. The chiefest of this kind are *Salt* and *Sulphur*.

XXII.
Mineral
Earths.

Mineral Earth, is a *Body* dug out of the *Earth*, consisting of *Terrestrial Particles*, joyned with a tough and viscus *Humidity*, reducible to *Powder*, and soluble in *Water*, so as thereby to be turn'd into a kind of *Clay*. Wherein it differs from *Mineral Coagulated Juices*, which are wholly dissolv'd in *Water*, and are not turn'd into *Clay* by admixtion of the *Aqueous particles*.

XXIII.
The various
kinds
of Mineral
Earths.

These *Mineral Earths* are various, according to the diversity of the *Particles* whereof they consist; or of the *Juice*, whereby their *Parts* are joyned together; as also of the *Country* where they are found. For if the *Matter* be very tough, ropy and unctuous, it makes *Potters-Clay*; if it be tough, white and dug up in the *Isle* of *Crete*, it is *Chalk*; if in the *Isle* of *Samos*, *Samian Earth*; if a yellow Colour, *Oker*; if Red, and found in the *Isle* of *Lemnos*, *Lemnian Earth*, and *Sealed Earth*, because it was used to be sealed with the Seal of *Diana's Priest*; if it be of a pale Red, and digg'd in *Armenia*, 'tis call'd *Armenian Earth*, or *Bole*. What *Stones* are, shall be delivered in the next Chapter.

XXIV.
In what
part of the
Earth Minerals
are
produced.

Minerals are not generated, like *Metals*, in the *Inward parts* of the *Earth*, where they have the whole weight of the *Earth* lying upon them; but about the *surface* of it, where its *Parts* are separated by infinite *Chinks* and *Crevisses*, by

which they give a free passage to *Vapours* and *Exhalations*, and to other *particles* of that *Matter*, which the *Heat* contain'd in its *Bowels* hath put into *motion*. And forasmuch as it is peculiar to *Exhalations*, to mingle themselves with the smallest *particles* of the *Earth* they snatch along with them, they by this means come to form certain little *Lumps* or *Masses*, which after various agitation acquire also the same *motion*; but that ceasing, they are all at last brought to a state of *Rest*, being clothed with a roundish *Figure*. And after this manner 'tis probable that the *Grains* of *Sand* are formed; which are *Heavy*, because they are compacted of *Terrestrial Matter*; *Hard*, because they are without *motion*; and *Transparent*, because they have *Pores* that transmit the *Globuli* of the *second Element* to right *Lines*, in the very same manner as they were moved, before that the *Particles* of *Sand* were yet *Coagulated*.

Tho' every single *gram* of *Sand* be transparent, nevertheless where many of them meet together, so as to make a *Heap*, they constitute an *opaque Body*; because in this state they cannot give a free passage to the *Light*, seeing that each *surface* reflects some *Rays* of it. Thus the *Powder* of *Glass* is not *Transparent*, because the various *particles* of *Glass* cannot have their *pores* so corresponding with one another, as freely to transmit the *Light*. Thus the *Grains* of *Sand*, especially those of the *Indies*, when beheld through a *Microscope*, be transparent, and resemble *Diamonds*; yet when they lye in *heaps*, they can no longer give free passage to the *Light*, and therefore constitute an *opaque Body*.

Potters Clay, notwithstanding that it is tough and fat, yet is produc'd much after the same manner as *Sand*; only with this difference, that the *Grains* of *Clay* are much less, which make their *Intervals* not to let in *water* so readily, nor indeed without some force.

If the *Particles* of *Salt* and *Oil*, which continually ascend from the *Inward parts* of the *Earth*, were always like one another, we should every where meet with the same kind of *Sand* and *Clay*: But it being very probable, that the said *Particles* of *Salt* and *Oil*, are not in all places the same; it is to be of no matter of Wonder to us, that the *Clay* and *Sand* likewise is not always the same, but differing in Colour and the Magnitude of their *Parts*.

CHAP. IX.

Of the Generation of *Stones*, Common and Precious, and of their difference and distinction.

STONES are *Mineral Bodies*, hard, and compounded of a petrifying *Juice*, and *Terrestrial Particles*, not subject to *Fusion*, but *Calcination* by *Fire*; nor malleable, but breaking to pieces under the stroke of the *Hammer*. These, according to the Purity or Impurity of the *Matter* whereof they consist, are divided into *Common* and *Precious*, which are either generated in the *Bowels* of *Animals*, or without them.

Some

XXV.
The Fella-
cid Grains
of Sand
being heap-
ed together,
make an
Opaque
Body.

XXVI.
How Pot-
ters Clay
differs
from Sand.

XXVII.
The reason
of the
difference
of Clay in
several
parts.

I.
What
Common
Stones are.

II.
New Stones
are daily
generated
in the
Earth.

Some are of Opinion, that there are no New Stones produced, but that all of them were created at the Beginning. But Miners assure us to the contrary, who often find Stones in those places, where before was nothing but Sand or Clay. Whence it is obvious to conclude, that both these are the matter of Stones, and that of the particles thereof variously joyned and mingled together, they are compounded. For tho' things made of Sand be hard, and cannot be softened; yet this nothing hinders, but that by the help of some Terrestrial matter, filling their Pores and Intervals, they may so hang together, as to constitute Stones. Thus it frequently happens, that Waters running through the Earth, do carry away with them some small particles of the Stones through which they run; which water coming afterwards to places where its Current is very slow, may give occasion to those particles to unite together, and constitute a Stone.

III.
A twofold
Rise of
Stones.

Stones may be made of Sand these two ways; first, out of dissolved Sand, as when Sand dissolved in any quantity, is afterwards hardened. And the Stones thus formed are transparent, as the single grains of Sand are, and are of various figures, according to the Compression of the Bodies that are lying about them. The other way is, when Stones are made of solid Sand; as when a great heap of grains of Sand, by the intervening of some Exhalation, do grow together: This way all opaque and rough Stones are made, which are proper for the grinding of Iron, and polishing of other Stones.

IV.
That there
is such a
Matter
wherewith
the parts
of Stones
are knit
together.

It is not to be doubted, but that much of this Matter is sublimed towards the surface of the Earth, in the form of such Exhalations as accompany the rising Vapours. This is evident in many Fountains, which notwithstanding that the water of them being very clear to the Eye, yet contains great store of them, which meeting and joyning together in some Parts, become sensible. Thus there is a River in Avergne in France, which doth so abound with these Exhalations, that the Channel of it is become Stony, swelling by degrees higher and higher. In like manner there are found some Springs which cover the Channels and Conveyances by which they pass, with a Crust of Sand-stone. And there is one at Rome, which stoppt the Pipe, through which its water passed, with Alabaster.

V.
How Mar-
ble is
formed.

The production of Marble doth not at all differ from the production of other Common Stones; save only that the Clay whereof it is made consists of lesser particles, and hath straiter Pores, which for that Reason are more easily fill'd with those Exhalations that stick to the Sides of them. And this makes the Composition of Marble more accurate, and the Texture of its parts more close and compact, than the common mixture of Stones is. Which may be easily gather'd from the smoothness of its surface, seeing that the Roughness of Sand-stones and Pumice-stones, and other such like, proceeds only from their Cavities. Now Marble is polish'd with Sand, by the rubbing whereof its prominent particles are worn away. In this Polishing, Water also is made use of; which being mix'd with the Sand, doth by this means more easily insinuate it self into the pores of these Particles, that are to be rubb'd off. There are several

sorts of Marble, some being White, others Black, some Transparent, and some Opaque; all which diversity proceeds from the various Contexture of their Parts.

For Transparent Stones are generated, when the Exhalations and Vapours being first changed into Juices, in the Chinks or Cavities of the Earth; afterwards by the departure of those fluid Particles, do come nearer together, and by degrees so cleave together, that the Globuli of the second Element have free passage through their pores, in order to the Transmission of the Action of Light. And on the contrary Stones become Opaque, when the Vapours that are shut up in the narrow Chinks and Clefts of the Earth, are there stoppt, and become so mingled with the Earthy particles, that the pores, in many places, are not wide and open enough to transmit the Light.

There are many kinds of Common Stones, viz. Marble, Flint, Touch-stone, Whet-stone, Pumice, and Sand-stone; Stones in the Bladder or Reins; Talck, Lead-stone, &c. Of Marble we have treated already.

Flint is almost the hardest of all Stones, and is commonly Round, and somewhat Flat, like Lenticles, and being dash'd against another, divides it self in two little Hemispheres. Because of its extreme hardness it is apt to leap back or rebound, since it neither yields, nor can be easily reduc'd to Powder. Its production is much like that of Marble, being found buried in Clay, as in its Matrix, whose pores being fill'd with the said Exhalations, procure it the great Hardness it hath.

Touch-stone belongs either to Marble or Flint. It admits of the most perfect Polishing, and is sometimes found very exquisitely smooth'd by Nature. For which Reason also it is very hard, and doth not admit any Division without difficulty.

A Whet-stone has a Roughness, which conduceth to the Smoothing and Grinding of Glass and Metal; in which Operation Water is sprinkled upon it: For the Water being pour'd over it, smooths and makes even the more sensible Asperities of the Whet-stone, and hinders it from acting too boisterously upon the Body that is to be Ground.

Pumice-stone is a Stone of an Ash-colour, full of great Cavities like a Sponge, into which it admits Moisture, but soon lets it go again. It is made use of for the Polishing of Marble; for by its Roughness it reduceth the prominent parts of Marble to smoothness.

The Sand-stone is formed in Holes, from whence the intercepted Matter derives its smoothness. Its Colour is white; because its particles are so dispos'd, as to reflect or send back the Rays of Light, in the same manner as it hath received them. Wherefore also it appears in the likeness of Froth. Tho' it be very Light, yet doth it not swim upon the Water; but the moisture entering into its pores, it sinks immediately.

Talck is a Stone that is Transparent, except it be too thick; for then it is opaque, by reason of the multiplicity of Surfaces heap'd one upon the top of another, and whose pores do not correspond exactly enough for the Transmission of Light.

VI.
Some Stones
are Dia-
phantous,
others
Opaque.

VII.
Several
kinds of
Common
Stones.

VIII.
Flint.

IX.
Touch-stone.

X.
Whet-stone.

XI.
Pumice-
stone.

XII.
Sand, or
Gravel-
stone.

XIII.
Talck.

XIV.
Stones
form'd in
the Body
of Man.

A Stone in the Body of Man, is formed in like manner as other Stones are, viz. by the Coalition of Sand, by means of some slimy Matter in the Reins or Bladder. It commonly inclines to a reddish Colour, and according to the different disposition of the Sand, is either smooth or rough; as we see that Stones that lye at the bottom of Rivers, are some of them smooth, and others very rough and uneven.

XV.
What pre-
cious Stones
are.

Precious Stones, are Bodies small in bulk, of a hard and strong substance; which either are Transparent, or of a lustrous Colour.

XVI.
How pre-
cious Stones
are gene-
rated in
the Earth;
and first of
such as are
transpa-
rent.

Gems are generated, not of a company of Sands grown together, as the Common Stones are; but of a certain fluid Matter, which only constitutes one grain; provided there be but so much of it, as to make some sensible Bulk, and such as is sufficient for a pellucid Body. Because that when the Exhalations that in the Clefts and Cavities of the Earth are gather'd into a Drop, by the loss of their slippery and fluid Particles, begin by little and little to cleave to one another, the Globuli of the second Element can on all sides freely and strongly enough pass through their pores; which could not be, in case they did consist of many grains: For how soft soever they might afterwards come to be, yet they could never be so joyned, but that there would be some Interruption, which would spoil their Transparency. And therefore these kind of Exhalations, according to the different degrees of their Hardness, and the various disposition of their Parts, are turned into Stones; as into Crystal, Diamonds, and the like. There is no difference betwixt a Crystal and a Diamond, save only that the particles of a Diamond are more closely knit together.

XVII.
Of Colour'd
Gems.

But if it so happen, that any Metalline particles be mix'd with this matter, that is common to all precious Stones; this causeth some modification of the Light that passeth through them, so that it produceth in us the sense of divers Colours; and thus instead of a Diamond or Crystal, we shall have several kinds of precious Stones, as Saphirs, Chrysolits, Jaspers, Agats, and the like.

XVIII.
The sever-
al kinds
of Precious
Stones.

Precious Stones therefore are divided into Transparent and Colour'd. The transparent are Crystal, the Diamond, and the Beryl, which have their Parts so ranged, as to leave Intervals, through which the Globuli may transmit their Action to Right Lines. The most precious of these is the Adamant, being of an exceeding Hardness, because of the close coherence of its Parts. Yet is not its Hardness such, as to be of proof against the strokes of a Hammer, as some relate, seeing that it may be grinded into Powder. So likewise the Common Story of its becoming soft in the Blood of a Goat, is no better than a Fable; and that it cannot be hurt by the Fire: All which Experience hath condemn'd of falsity.

XIX.
Crystal.

Crystal is of an Hexagonal figure; for every particle of Crystal being surrounded and kept in by six others, it must necessarily admit of a six Corner'd figure. There are some that affirm, That Crystal by the strength of the Fire can be melted; whereas others assert the contrary, and that after utter Diligence used, they could never bring it to Liquefaction. Some of the Ancients believ'd, that Crystal was the effect of extream Cold; but this is a vain Imagination, for all confessing Crystal to be

a Stone, we cannot attribute its Coagulation to Cold. DIO DORUS was better advis'd, who Lib. II. tells us, that Crystal is a Stone coagulated out of pure Water, not by Cold, but by the virtue of a Divine Fire.

The Beryl hath a great resemblance with Crystal; it is chiefly found in the East Indies, according to PLINY, at least the best and most lustrous are found there. For those we have from Babylon are of a kind of greasy Colour; yea, it is said, that there are Beryls found in Germany of the Colour of Oil.

The most Noble of all the Colour'd precious Stones is the Carbuncle, of a Red colour, and resembling the flame of Fire.

The Chrysolite is a Gem of a Golden colour, whence it took its Name; transparent and very hard.

The Hyacinth is of a Yellow colour, resembling the lustre of Gold.

The Emerald is the most precious of all Gems, and well nigh the most Brittle too, for it is easily broken. It is of a Green colour, like Grass.

The Topaz approacheth to the Colour of an Hyacinth; tho' some do say it is of a Green colour. It is said, that when it is laid under the Sun-beams it represents a Star; which is rather the effect of its form and colour, than of any peculiar Nature.

The Turcois is a precious Stone, of a Sky colour mixt with Green.

The Amethyst is much of the same softness as Crystal, and is found in the same place. It is of a Violet Purple colour, very grateful to the sight.

The Gem Morion, is of a very Black colour.

The Agate admits of all Colours, as having white, black, and other variegated streaks in the midst of it. And by this diversity of its colours, it is represented of divers kinds, by those who have a mind to deceive the Buyers.

The Jasper is a Green stone, with the mixture of Bloody spots. The best are those that come from the East.

The Ruby takes its names from the glorious Red colour wherewith it sparkles.

The Granat is also of a Red colour, but with some mixture of a Yellow; so called, because of its likeness to the grain of a Pomgranate.

The Onyx is the Alabaster of the Ancients, but much more precious than that which we commonly call so; it resembles the colour of the Nail of a Mans Hand, with some Veins running through it, which imitate the colour of a Jasper.

The Sapphire exceeds the other Gems in Beauty, and is of a Sky Blew colour, resembling the lively colour of the Sky, by its wonderful lustre, and extraordinary perspicuity. It is the hardest of all precious Stones, next to the Diamond.

There are also other Stones which are reckoned amongst the Precious, as the Pezar, or Bezear, Pearls, Chelidonium or the Swallow-stone, &c. But these do not seem to deserve the name of Gems; because the Pezar, which is found in the Stomach of a Beast called Pezain, is too soft to deserve that name. Pearls which are found in the shells of Oysters and Muscles are of too dark and faint a colour, and without transparency. And the Swallow-stone, which is found in the Stomach of Swallows, hath nothing in the least in it that resembles a Gem.

CHAP.

XX.
The Beryl.

XXI.
The Carbuncle.

XXII.
The Chrysolite.

XXIII.
The Hyacinth.

XXIV.
The Emerald.

XXV.
The Topaz.

XXVI.
The Turcois.

XXVII.
The Amethyst.

XXVIII.
The Morion.

XXIX.
The Agate.

XXX.
The Jasper.

XXXI.
The Ruby.

XXXII.
The Granat.

XXXIII.
The Onyx.

XXXIV.
The Sapphire.

XXXV.
Of other
Stones that
are counted
amongst
the Precious,
but are not
so.

C H A P. X.

Of the Load-Stone, and Electrical Bodies.

I. Of the Original and Composition of the Load-stone, and what its Nature is.

THo' the Load-stone be reckon'd amongst Common Stones, yet doth not the Earth produce any thing more wonderful than it, the effects whereof, as they were matter of Astonishment to the Ancients, so do they still puzzle the Brains of the Greatest Philosophers. This wonderful Stone is compounded of thick and branchy Particles of the Earth, approaching to the Nature of Iron; since there is no Iron Oar, which hath not much Earthy matter joyn'd with it; nor any Load-stone, which doth not enclose more or less of Iron. Yea, so great is the affinity between the Load-stone and Iron, that they are both digged out of the same Mines; and if we will take the word of GILBERTUS, the best Iron is got out of the Load-stone.

II. The Definition of the Load-stone and Iron.

The Load-stone therefore is a Stone, resembling the Matter that constitutes the Middle part of the Earth, which having Pores from one of its Poles to the other, fitted for the free passage of the striate Matter, can turn it self towards one of the Poles of the Earth. It is said to resemble the Middle part of the Earth; because the Load-stone, of all other Stones, seems to be of the same make and composition with the Middle part of the Earth. By the striate Matter mention'd in the Definition, we are to understand the Matter of the first Element, twisted in the manner of the Tendrils of a Vine or Ivy-Bush. It is said, that it can turn it self to one of the Poles of the Earth; because a Load-stone being left without impediment, always turns it self to the Poles. Iron is a Metal of Affinity with the Load-stone, endued with Pores, accommodated for the free passage of the striate Matter, by which means it is able to turn it self to the Poles of the Earth.

III. The Virtues of the Magnet may be referr'd to three Heads.

The Virtues of the Load-stone may be referr'd to three Heads; whereof the First is, that being in a free position without any thing to hinder it, it spontaneously directs it self to the Poles of the World. Secondly, That it draws Iron or another Magnet to it self, and sometimes also repels the same. Thirdly, That by a Touch it communicates to the Iron, as well the virtue it hath of pointing to the Poles of the World, as that whereby it draws Iron.

IV. The Celestial matter is the Cause of all the Motion in the World.

For the better understanding of these Virtues of the Load-stone, we are to suppose in the First place, that the Heavenly matter is the Principle of all the motions of the World; which, as it consists of most subtil and thin parts; so it easily penetrates the Pores of all Bodies, and according to the different degree of its agitation, doth put them into motion, and push them forward; and being fluid, doth accommodate it self to the narrow Spaces through which it passeth, and puts on various Figures, according to the diversity of their situation; so that its particles which pass through the Triangular Spaces, which are left in the midst of three Globuli of the second Element touching one another, must take upon them a Three-corner'd figure, which we may conceive as so many little Pillars, with three hollow'd Channels, winding like a Screw. And this more or less, as they pass

nearer to, or further from the Axis of the Vortex, because the Globuli of the second Element move more slowly in the former part of the Vortex, than in the latter; as it hath been declared more at large in the Fifth Part of this Institution.

We are likewise to Note, that because the Striate particles come towards the Middle of Heaven from contrary Quarters; that is, some of them from the South, and others from the North Pole, whilst in the mean time the whole Vortex is moved one and the same way; therefore those Particles which come from the Southern Pole, cannot have their Screw turn'd the same way, as those which come from the Northern Pole, but the quite contrary.

Again, we are to suppose that in the Region of the Earth C A D B, there are many Pores parallel to its Axis, through which the Striate, or Screw-like Particles, coming from the parts about one Pole, may pass freely to the other opposite to it; but forasmuch as they are writb'd a contrary way, and that the one go one way, and the other quite opposite, the Pores which admit the Striate particles that come from the South Pole A, will never be able to receive those that proceed from the North Pole B. Whence it comes to pass, that those Particles that proceeded from one Quarter, can never return by the opposite part, because of the different writhing of the Pores, and because of several most minute fibres arising in them, which obstruct their return. So that after the Striate Particles have run through that Great Load-stone, the Earth C A D B, in Right Lines, or equivalent to such, from one Hemisphere to the other; or from the North B to the South A, or else quite contrary from A to B, they are forced to return to the same Hemisphere through which they at first entred the Earth.

So that about every Magnet, as well as about the Earth, C, A, D, B, a perpetual Vortex of the Striate Matter, which is manifest from this Experiment, that if you cast the filings of Iron or Steel round about a Load-stone laid upon Paper, the said filings will dispose themselves a-round the Load-stone in manner of a Vortex. Wherefore if you shall direct the North Pole of a Load-stone you hold in your hand, to the North Pole of another Load-stone plac'd upon a piece of Cork in a Basin of Water, the North Pole of the later Magnet will turn away from that you have in your hand. But when the Load-stone placed on the Water, being turned about, directs his South Pole to the North Pole of the Magnet in your hand, then it will approach to it, because the interjacent Air being driven away by the Striate Matter, the Loadstone is also pusht forwards by the Air that surrounds it. Whence it is that the Poles of a Loadstone are said to be of a contrary virtue.

And if by chance the Striate Particles, in passing from one Hemisphere to another, do there meet with the Load-stone I, K, L, M, N, forasmuch as they find in the same, Pores ranged in the same manner, as the Pores of the inward part of the Earth, they easily and freely pass through them; especially if the Load-stone be so posited, as to have the arrangement of his Pores turn'd towards that quarter, from whence the Striate Particles proceed.

More.

V. The Striate Particles are variously crook'd and turn'd.

VI. How the Striate Particles, that proceed from the Earth, do affect the Load-stones that come in their way.

Figure 2. I.

VII. About every Magnet a Vortex is formed, as about the Earth.

VIII.
The Striate
Particles
do not so
easily pass
through
the Air or
Water, as
through the
Earth.

Moreover we are to observe that the *Striate Particles* cannot pass so freely through the *Air* or *Water*, as through *Iron*; for they being *fluid Bodies*, their parts cannot always keep the same situation, and therefore if at any time such *pores* come to be formed in them, they are presently again spoil'd and confounded by the continual agitation of their *Parts*. Those *Bodies* only are disposed to admit the *Striate Particles*, that consist of *Thick* and *Branchy Parts*, such as rationally we may believe *Iron* and *Steel* to have. For of all *Metals*, none is either with more difficulty melted in the *Fire*, or extended under the *Hammer* than *Iron* is, or made *harder* without the addition of any other *Body*: which three instances abundantly shew, that the *Particles* whereof it consists must be *Angular* and *Branchy*, which is the reason they are so closely knit together, this being the most necessary condition in order to the free transmission of the *Striate Particles*. For we find that *Iron* temper'd and hardned, doth more freely afford them passage, than other *Iron*; and so likewise 'tis observed, that when the *Iron* is smooth and burnisht, the *Striate Particles*, that proceed from one *Pole* do more orderly return to the other.

IX.
In every
Magnet are
two Poles,
an Axis,
and Parallel
Lines.

Figure
42.

For the better understanding of this *Magnetic* virtue, we are to take notice, that in every *Load-stone* there be 2 *Poles*, *South* and *North*. The *South Pole* is the *Point A*, being the middle of that part wherein are the *Orifices* of the *Pores*, by which that *Striate matter* enters, which comes from the *South part* of *Heaven*: and the *North Pole* is the middle of the other part, by which these *Striate Particles* go forth, and others coming from the *North F*, do enter. Besides the *Poles*, considered in a *Load-stone*, there is also its *Axis*, or the *Diameter* from the *North point F*, to the *South A*, drawn through the *Center* of the *Load-stone*. And lastly, its *Parallel Lines*, which being drawn from the *North* to the *South*, are at an equal distance from the *Axis* of the *Load-stone*.

X.
Why the
Magnet
points to
the Poles of
the Earth.

These things being premised, it will not be difficult to explain, why a *Load-stone* turns its *Poles* to the *Poles* of the *Earth*; because the *Magnetical Particles* coming from the *North Pole F*, and *South B* of the *Earth*, rushing obliquely against the *Poles* of the *Magnet*, do push it this way and that way, till that they can freely, that is in right lines, pass through its *Pores*.

XI.
How one
Load-stone
turns to
another.

And it is for the same reason that one *Load-stone* turns to another. But it is to be observed, that the *South pole* of the *Magnet* always turns to the *North pole* of the *Earth*, or of another *Load-stone*; because the *particles* that come forth from the *South pole*, are writhed another way than those that enter. Whence it is that the *Poles* of the same denomination do always flee from one another. As for instance, suppose we that the *Poles* of 2 *Magnets* be turned to the *North Pole* of the *Earth*; these 2 *Poles* are of the same Denomination, because the *Particles* that flow from the *North Pole* of the *Earth*, do act upon them after the same manner; but it is apparent that these *Poles* flee one another, and therefore would flee from the *Pole* of the *Earth* also, in case they were of the same Denomination with it.

XII.
A Load-
stone flees
from ano-

For the same Reason it is that a *Load-stone* being set on one end on its *North Pole*, and swimming on a piece of *Cork* in the *Water*, if to the *South Pole*

of this *Load-stone*, the same *Pole* of another *Load-stone* be applied, the *Cork* flees away from it; for seeing that the *Particles* cannot enter those *Pores*, they require some space, in the which turning themselves, as in a *Vortex*, they may return to their *North Pole*.

When the *North Pole* of one *Load-stone* is turned to the *South Pole* of another, and that the *Spheres* of both of them become one, then they approach to each other; because in this case they act with their joyn't forces upon the *Air*, and therefore make it withdraw; which, by its *Circulating*, pusheth on both the *Magnets* till they come to touch one another.

But some, it may be, will demand, Why for the same Reason the *Poles* of the same denomination do not as well come together; or, why the *Magnet* doth not approach to their *Bodies*, seeing that the *Air* in both cases is alike prest upon?

The Answer to this is obvious, for the *Magnetical particles*, because of their different way of wreathing, finding no fit passages for themselves in the *Pole* of the same denomination, do greatly hinder this Conjunction. And the same is the reason, why it doth not draw near to other *Bodies*, since the *Magnetical matter* doth not find any corresponding *Pores* in them.

From what hath been said, it will not be difficult to explain, how a *Load-stone* draws *Iron* or *Steel*; or rather how a *Load-stone*, *Iron* and *Steel* draw near to each other: by saying that the *Load-stone B* attracts the *Iron C* because both their *pores* are so disposed, that the *striate matter A*, which comes from about the *Poles* of the *Heaven*, and continues its course through the *pores* of the *Earth*, that are parallel to the *Axis* thereof, passing more easily through the *pores* of the *Load-stone B*, and of the *Iron C*, than of other *Bodies*, drives away the intermediate *Air*. Now because the *Air* finds no place (for there is no *Vacuum*) to which it might pass, but that which is left by one of these two *Bodies*; it cannot be otherwise, but that the *Load-stone B*, must be push'd towards the *Iron C*, or the *Iron C* towards the *Load-stone B*. For this is a General Rule, That the *Virtue* of the *Load-stone* is increased or diminished, according to the approaching or withdrawing of the *Iron*. It is increased, when the *Load-stone* and *Iron* are so disposed, as that the one sends its *Striate particles* into the other; but diminished, when the *Iron* is withdrawn from the *Magnet*, or the *Magnet* from the *Iron*. For the *Communication* of the *Striate matter* being by this means removed, their force must needs be weakened and lessened.

This will not be hard to conceive, if we take notice, that the *Parts* of the *Air*, as of all other *fluid Bodies*, are in continual motion, and that therefore of necessity they must push continually towards the *Load-stone B*, which they surround on every side: And because they equally push it forwards on all sides, they do not push it more one way than another. But when the *Air* is driven out of its place by the *Striate matter*, proceeding from the *Magnetical Body* at *A*, it so happens that the *Magnet* is less push'd forwards on that side, than on the other, and so approacheth to the *Iron C*, or on the contrary.

ther, if it
be apply'd
to the
same Pole.

XIII.
Whereas it
draws near
to it, when
apply'd to
the opposite
Pole.

XIV.
Why the
Poles of a
Load-stone,
that are
of the
same deno-
mination,
do not unite
or come
together.

XV.
How a
Load-stone
attracts
Iron.

XVI.
How the
Air should
be driven
forward
by a Body.

Where-

XVII.
The Sphere
of the
Magnetick
Attraction.

Wherefore the *Sphere of Magnetick Actions* is conceived to be about the *Circuit D E*, within which the *Striate particles*, composing the *Vortex* from *F* to *G*, can affect *Bodies* that have their *Pores* dispos'd alike. And this *Sphere* is by so much the greater, as the *Load-stone* is bigger, or at least the longer it is; because the *Magnetick matter*, passing through the longer *Pores* of it, thereby acquires the force of passing farther in a *strait Line* in the *Air*; which makes, that the *Virtue* of great *Load-stones* doth reach farther than that of small ones.

XVIII.
The Mag-
net doth
not prop-
erly draw
Iron.

Hence it appears, that the *Load-stone B*, cannot properly be said to draw the *Iron C*; because in this *Action* there is no *Attraction* at all, but as soon as the *Iron C*, is placed within the *Sphere* of the *Activity* of the *Load-stone B*, it gets strength, and is carried towards the *Magnet*; which *Action* doth not so much deserve the Name of *Attraction*, as that of *Circumpulsion*, or of being push'd forwards on all sides.

XIX.
Why an
Armed
Load-stone
draws much
more Iron,
than a
bare one.

Figure
43.

There still remains one *Difficulty* behind, which is this: If there be so great a *Correspondence* betwixt the *Pores* of a *Load-stone* and *Iron*, how comes it to pass, that the *Load-stone A B*, armed with *Iron*; that is, to which the *Iron Plates C D*, and *E F*, are fastned, should carry much more *Iron*, than one that is bare. To which I return this Answer, That this greater Force or *Virtue*, doth not proceed from the *Iron* that is fastned to it, but from the *contact* of it; because the *pores* of the *Iron Plates C D*, and *E F*, do exactly answer to the *Pores* of another *Iron*, and their *Parts* are so joyned, as to appear immediately to touch one another. Whence it is that the *Striate matter* passing through these *Pores*, from the *Iron* fastned to the *Load-stone*, to another *Iron b a*, doth with more ease drive away the intermediate *Air*, and make them more closely cleave together. Now the *Pores* of the *Magnet*, cannot so immediately agree with the *Pores* of the *Iron*, by reason of its *Impurity* and *Stony Nature*. Which makes, that there is always some *Interval* between the *Load-stone* and the *Iron*, by which the *Striate matter* doth remove from the *Pores* of the one, to those of the other.

XX.
The Con-
trariety
of the
Poles of
the Load-
stone, do
not hinder
their con-
currence to
bear up
the Iron.

Neither doth the *Contrariety* of the *particles* of the *Striate Matter*, whereby those that enter at one *Pole*, cannot enter in by the other, hinder them from agreeing to bear up the *Iron*; because those that come from *A*, the *South Pole* of the *Load-stone*, being reflected by the *Steel-plate*, enter in at one part of the *Iron b*, in which they make its *North Pole*, and flowing from thence to the *South Pole a*, they meet with others of the *Steel-plate F E*, by which they mount up to *B*, the *North-pole* of the *Load-stone*; and on the contrary, those that go out from *B*, through the *Plates F E*, the *Iron* that hangs at it *H G*, and the other *Plate D C*, return to *A*.

XXI.
Why a
Load-stone,
be it never
so strong,
cannot
draw an
Iron that
is not con-
tiguous to

Neither can any other Reason be given in my Judgment, why a *Load-stone*, tho' never so strong, cannot withdraw an *Iron* that is distant from it, from the *contact* of another, tho' much weaker *Magnet*; because tho' the *Striate particles* pass through both those *Magnets*, and the intermediate *Iron*, so that one only *Load-stone* is made of them all three; yet by reason of the *Contact*, and a greater agreement of the *parts*, the *Iron* cannot

be withdrawn from a weaker *Magnet*, to which it is joyn'd, by a stronger. Forasmuch as the *Load-stone*, not only joyns the *Iron* to it self, but over and above communicates its *virtue* to it.

It remains still to be explained, how the *Load-stone* communicates its *virtue* to the *Iron*, without any loss of its own strength and *virtue*. The *Iron* acquires this New *virtue*, when it hath *pores* fit for the receiving of the *Striate Particles*, and so situate, that they can freely pass through them, as hath already been said. For nothing is wanting to it towards the acquiring of this *Virtue*, save only that some small ends of the *Branchy particles*, which stick out here and there in those *pores*, must all of them be turned away in those *pores*, through which the *Striate Particles* that come from the *South* are to pass; whereas in the other *pores* they must be turned the quite contrary way. Now as soon as the *Load-stone* toucheth the *Iron*, the *Magnetick particles* rush with great force and in crowds into the *pores* of the *Iron*, and by this means bow these *Extremities* of the *Branchy particles*; and consequently contribute all that which was requir'd to the *Magnetick virtue*.

Hence it is, that when a *Gad* of *Steel* or *Iron* being Red-hot, is set to cool, with its *Extremities* turn'd directly *North* and *South*, it is, by reason of its *contexture* and *pores*, which the action of the *Fire* hath clear'd and opened, immediately penetrated by the *Magnetick Effluvia*s of the *Earth*; which continually do courie it through the *Air* from one *Pole* to another, and so becomes endued with a *Magnetick property*: Which doth not so happen in an *Ingot* of *Silver* turn'd *South* and *North*, and that because of the difference of its *Contexture*, and disposition of its *Pores*.

An *Iron* differently receives the *Magnetick virtue*, according to its different way of application to the *Load-stone*. For the part *R*, of the *Iron R S T*, if it be apply'd to the *North-Pole* of the *Magnet P*, will become the *South Pole* of the *Iron*; because the *Striate particles* coming from the *South*, will enter in by it, and the *Northern* will enter in by the part *T*, being reflected or beat back from the *Pole A*, through the *Air*. And the same part *R*, if it lye upon the *Aequator* of the *Load-stone*, and look towards its *North Pole*, as in *C*, it will again become the *South Pole* of the *Iron*. But if it be turn'd about, and look towards the *South Pole*, as in *D*, then it will lose the *Virtue* of the *South Pole*, and become the *North Pole*. Lastly, If the *Middle part* of this *Iron S*, touch the *Pole* of the *Magnet A*, the *Northern Striate particles* which have entred into it by *S*, will go out again by *R* and *T*; and by this means the *Iron* will receive at both ends the *Virtue* of the *South Pole*, and in the midst that of the *North*.

It may be Queried, why those *Striate particles*, that from the *Pole A* of the *Magnet*, do enter the part of *Iron* marked *S*, do not directly pass on to *E*; but are reflected this way and that way towards *R* and *T*; so as the *Iron* receives the *Magnetick virtue*, rather according to its *Longitude*, than to its *Latitude*? The Answer to which is obvious, viz. because they meet much more free and open passages in the *Iron*, than in the *Air*; for which Reason they rebound from the *Air* towards the *Iron*.

F f f

There

it from
another.

XXII.
The Load-
stone com-
municates
its Virtue
to the Iron.

XXIII.
How Red-
hot Iron
comes to
acquire a
Magnetick
Virtue.

XXIV.
How it
comes to
pass that
an Iron,
according
as it is
variously
apply'd to
a Load-
stone, doth
also differ-
ently re-
ceive its
Virtue.

Figure
44.

XXV.
Why a long
piece of
Iron doth
not receive
this Vir-
tue, but
in its
length.

XXVI.
A Plate
of Iron
binders
the attra-
ctive Vir-
tue of the
Load-stone.

Figure
45.

XXVII.
Iron is
more apt
to receive
the Mag-
netick Vir-
tue accord-
ing to its
length,
than
breadth.

XXVIII.
And this
in a mo-
ment.

XXIX.
Steel better
keeps the
Magnetical
Virtue, than
common
Iron.

XXX.
The Reason
why a
Load-stone
loseth no-
thing of
its Virtue.

XXXI.
By what
Efficiency
Glass and
Amber
draw to
them bits
of Straw
and Stub-
ble.

There is also another Difficulty remains to be explained. viz. how the Iron Plate D C D, being apply'd to the Pole of the Magnet A B, which, we said before, did much help the carrying or bearing force of the Load-stone, should notwithstanding hinder its force of attracting and turning Iron to it; so as to make the Point E of the Magnetick Needle E F, not to be directed to the Pole of the Magnet B, but towards the end of the Iron Plate D. To which we Answer, That the Striate particles, which, if this Plate had been out of the way, would have past from B, toward E F, are diverted by it from C, towards the Extremities thereof D D, because they find a more ready and free passage for themselves through the whole length of the Plate from C to D, than through the small interval of its thickness C. To this may be added also, that the Striate particles do pass more freely through the Plate, than through the Air, so that scarcely any of them reach the Needle E F.

Wherefore, tho' Iron be made partaker of the Magnetick virtue, yet doth it more readily admit it according to its length, than according to its breadth, even then when the Middle part of it is applied to either of the Poles: The Reason whereof is, because the Striate particles proceeding from the Load-stone, do find fitter Pores for them in the Iron, than in the Air, which is the reason why they go towards it. This likewise is the Cause why Needles endued with the Magnetick virtue, have the Poles of their virtue at their Ends or Extremities.

This Virtue is communicated, as it were, in a moment, the course of the Magnetick particles through the Iron being very swift; because they meet with, in the Iron and Magnet, Pores exactly fitted to their figure. Now this Virtue is afterwards confirmed by long stay; for the longer that the ends of the Branchy particles have continued turn'd one way, it is with the more difficulty that they are turn'd the contrary way. This Virtue is longer retain'd in the Load-stone, than in the Iron; because the parts of the Magnet are more stiff and inflexible, by reason of the Stony matter that is mixed with them.

Hence it is that Steel receives a greater Magnetick virtue than common Iron, forasmuch as it hath more and more open Pores, and doth more surely keep, and preserve the same; because its Branchy particles are more stiff and rigid.

The Reason why the Magnet, tho' it communicates its virtue to the Iron, yet loseth nothing of it, is, because nothing of its Substance or Constitution is destroy'd by this Contact, seeing this whole operation is performed by the Striate matter; which tho' it be hurried forceably and abundantly through the Pores of the Load-stone, yet by its passage takes nothing from the Magnet, nay, rather its virtue by this free communication thereof, is much increased.

And here, seeing that besides the Load-stone there be some other things that draw to them outward Bodies, such as Glass, Amber, Jet, Diamonds, which attract bits of Straw and Stubble; it will not be amiss to say something of them. And first concerning Glass; it seems probable that besides those Intervals, which in other Bodies give a free passage to the Matter of the first Element,

there be some Long pores like unto slits, and so narrow, that they are only fit to admit the Matter of the first Element, without being capacious enough to receive the Globuli of the second Element. And forasmuch as the Matter of the first Element, accommodates it self, as hath been said, to the Pores through which it passeth, and assumes their figures, as it is wandering through those little Slits or Chinks, it becomes turned into certain Wreaths or Twists; which because of the various disposition of the parts of Air, being not able to penetrate its Pores, do remain in their own lodging, and there move from one Chink to another by a Circular motion. So that when a piece of Glass is rubb'd hard and swiftly against some other Body till it grow hot, the particles lodged in the Glass are by this agitation first thrust out of their places, and so being driven from the Glass, and flying through the Air, penetrate the Pores of other Bodies: But because they cannot so freely course it between their parts, they soon return to the Glass again, and carry along with them those small Bodies, out of whose Cavities they cannot extricate themselves. And the same may be said of Diamonds, Amber, Jet, Resin, Sealing-Wax, and the like, since we suppose the same Intervals or Pores in them, viz. such as only can admit the Matter of the first Element, and that their Particles have the same force to enter the Pores of Bodies, and of carrying them along with them.

CHAP. XI.

Of Water.

WATER is a congested Mass of Particles of the Third Element, which are very thin, longish, smooth, and therefore very flexible, resembling small plying Cords, disposed to bend and yield every way.

That the Particles of Water are smooth, may easily appear by Bodies that are wetted therewith; which with the least degree of Heat, or with the motion of the Air only are dried. For the Particles of Water are by this means separated, and by force of the Motion of Heat, or the Agitation of the Air, driven out from the Bodies to which they were joyned. Hence it is, that Water is not frozen without some difficulty; for its Particles being smooth, are readily separated from one another, by the Agitation of the Aethereal matter.

Now that these Watry particles are in continual motion, besides what we have already cleared in our General Physiology, may be proved by these Instances, viz. that Liquors pour'd together do readily mingle; that Oil and Water, by strong shaking, become incorporated together; that Colours and Tastes are, as it were, in an instant diffus'd through all the parts of them, and other such like, which occur to our daily Experience.

Forasmuch as the Subtil matter is in perpetual motion, and never ceaseth to agitate the Bodies, through which it passeth; it needs not seem strange to us, that it should make the Water Liquid, seeing it moves all its Particles one by one, and bends them one upon another. And on the contrary, when

I.
What Wa-
ter is.

II.
The Partic-
les of Wa-
ter are
smooth.

III.
That the
Particles
of the
Water are
in conti-
nual moti-
on.

IV.
Whence
Water hath
its Liqui-
dity.



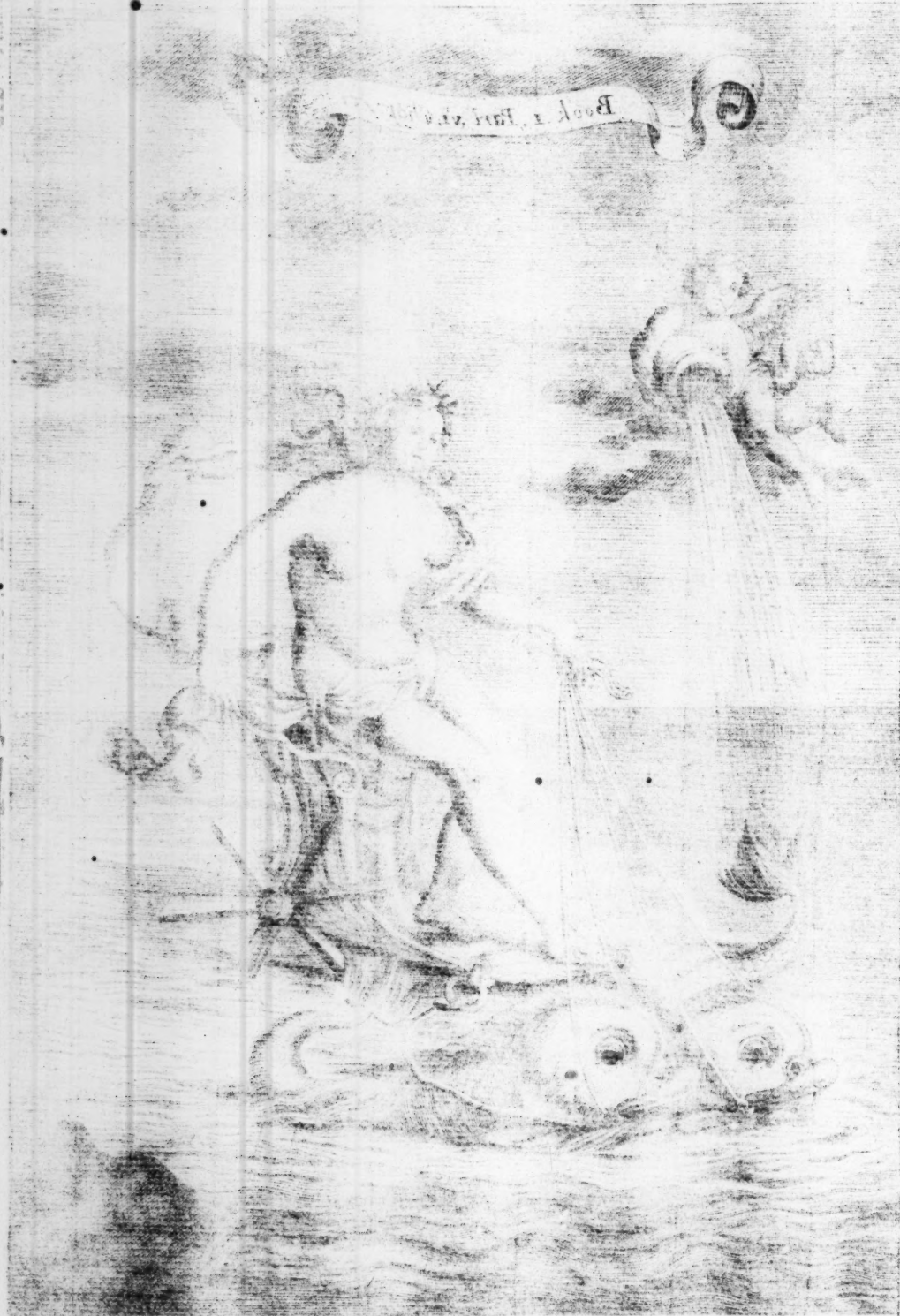
*The Honourable
Haddock Knight
their Majesties*



*S.^r Richard
Comptroller of
Navy Royall &c.^o*

This Plate is humbly

Dedicated by Richard Blome.



The Honorable
 Robert R. R.
 Esq. of the
 House of Commons
 in Parliament assembled
 by Order of the House
 Printed by W. Baskett
 at the Sign of the Sun in Pall Mall

when this its Force is hindred (which chiefly happens in *Winter* time, because of the *Suns* distance) the parts of the *Water* being promiscuously huddled together, and without order heap'd upon one another, remain immovable, and constitute that which we call *Ice*. Which Consistence of the Parts, is the Reason why *Frozen Liquors* are so cold, for that their Parts being deprived of the agitation of the *Subtil matter* are closely joyned, and therefore cannot admit any greater particles of the said matter or heat.

Water is never frozen, but when the *Heavenly matter* which runs betwixt the *Watry Particles*, becomes more subtil than is customary; by which means it comes to pass, that the *Pores* of the *Ice* being reduced to the measure of these lesser particles of that matter, do shut out those that are never so little bigger. For which Reason it is that *Ice* is extrem cold, and always keeps its Hardness, tho' it be kept till the midst of *Summer*. Neither doth it grow soft by little and little, as *Wax* doth, forasmuch as by reason of the narrowness of its pores, the heat cannot enter into the Inner parts of it, but as the Outward parts of it begin to melt.

There are two sorts of particles in the *Water*, *Flexible* and *Inflexible*: The *Flexible* particles are those, which are agitated by the *Heavenly matter* that surrounds them; and of these, *Fresh-water* is composed. These *Flexible* particles have no *Elastic force*, and apply'd to the *Nerves* that are dispers'd through the *Tongue*, they produce no *Taste*; for wherever they meet with the least resistance they slip away. The *Inflexible* parts of the *Water* are stiff and sharp, like so many *Swords*, and these constitute *Salt*. As appears from what hath been said before.

Hence we may see the Reason, why *Salt-water* as it were pricks the *Tongue*; for since the *Saline particles* cannot be made to ply or bend, by the *subtil Matter* which surrounds them, they continue stiff, and as so many sharp-pointed *Needles* enter the pores of the *Tongue*, and entering, prick them with their Points: Whereas the parts of *Fresh-water* lye smooth upon the *Tongue*, and touch it not with their Points, but with their Sides.

It also appears from what hath been said, why *Salt-water* is more heavy than *Fresh*, viz. because it abounds with thicker and more solid Parts, which therefore cannot be resolv'd into *Vapours*: For the *Saline particles* being long and strait, they cannot long continue suspended in the *Air*, but that one end of them must hang downwards, which is an obstacle to their mounting upwards. But *Water*, whether *Salt* or *Fresh*, is lighter than the *Earth*; because quantity for quantity, it hath less Force to withdraw it self from the Center of its motion, than the *Earth*.

Water is made *Transparent* by the *Globuli* of the second Element, which continually passing through the pores of it, and being of sufficient force to remove some of its particles, by this means easily form therein passages fitted for the transmission of *Light*. And as for those *Liquors* which are dark and troubled, the Reason thereof is, because their parts are too thick to admit the *Globuli* of the second Element. As is apparent in *Blood* and *Quicksilver*.

The Surface of the *Water* is kept smooth and even, by the motion of the *Air*, which continually presseth down its Outward parts; whence it is that small *Needles* being laid softly upon the Surface of it do not sink, but make a kind of hollow under them; but when once the surface of the *Water* is divided, they immediately sink to the bottom.

Tho' the *Water* do admit the *Light*, as well as the *Air*, as being capable of the Rectilineal pressure of the Matter of the second Element, continually passing through its Pores; yet is it not so susceptible of Sounds as the *Air*, because its parts are thicker and more slowly moved. Hence it is that *Vessels* fill'd with *Air* being struck upon yield a Sound; but not those that are full of any *Liquor*. And for the same Reason, *dry Wood* is more susceptible of Sound, than *Green-wood*; because the pores of *Dry-wood* have the same respect to those of *Green-wood*, as an Empty Vessel hath to one that is full; the pores of the *Dry-wood* being open and empty, whereas the other are stop'd up.

It is a Question much canvass'd, whence the Saltiness of the Sea proceeds? Which may be thus answer'd, That the same is caused by the *Salt* which is mingled with its Waters: For *Sea-water* abounds with *Salt*, as appears by its distillation; for the *Water* distill'd from it is sweet, and the *Salt* remains in the bottom. What some say, that the Sea borrows its saltiness from some Veins of *Salt*, doth not seem probable; because if those *Veins* be near the *Water*, they must needs have been all dissolved long before this; for *Salt* immediately dissolves in moisture. And if the waters do not touch them, how shall they communicate their saltiness to them? We conclude therefore, that the Sea is salt, and continues so, because it abounds with many inflexible and stiff Parts; which tho' they may get up into the *Air* for some time, yet by reason of their Thickness, soon fall down thither again. Which is the Reason also, why they cannot, together with the flexible particles, pass through the *Sand*, but are left behind.

But tho' the Sea be salt, yet *Fresh water* hath been sometimes found in the midst of it, and that by reason of the many subterraneous Channels of *Fresh-water*, which are found at the bottom of it. Thus we see, that the Sea about the shoars, which are near to the Mouths of great Rivers, is less salt; because the *Fresh water* of the Rivers overpowering the *Salt-water*, continue to be fresh for some distance in the Sea. As may be seen at the Mouth of the River *Rhône* in France, where the *Salt-water* doth not mingle with its *Fresh-water*, till at some distance.

We are not to think with some Modern Philosophers, that *Water* is cold in its own Nature: For tho' it feels cold, when frozen, this only happens to it from the Rest of its parts, wherein the Nature of Cold consists. But when it is in its Liquid form, it is indifferent to Heat or Cold, as being naturally susceptible of a greater or less degree of Agitation, according to which it appears hot or cold. So that when heated *Water*, by degrees is reduc'd to its former coldness; this proceeds not from its Natural propension to Coldness, but because it communicates some part of its Agitation (wherein its heat doth consist) to some Neighbouring

X.
Why the Surface of the Water is smooth and even.

XI.
Why the Water is not so fit to receive Sounds, as the Air.

XII.
Whence the saltiness of the Sea proceeds.

XIII.
The Sea being salt, how comes it to pass, that Fresh-water is found in it?

XIV.
Water is not Naturally cold.

V.
How Water becomes turn'd to Ice.

VI.
Some parts of the Water are flexible, and others inflexible.

VII.
Why Salt-water pricks the Tongue.

VIII.
Salt-water is more heavy than Fresh-water, and lighter than Earth.

IX.
Why Water is transparent.

bouring Bodies. And therefore when *Hot-water* is so close shut up in any *Vessel*, as to have no Communication with any ambient Bodies, it preserves its heat for a long while. *Running-water* therefore seems to be of such a Temperature, as to be a kind of Mean betwixt the Excess of Heat and Cold; seeing that by great heat it would all vanish into Vapours, and by excess of cold be lock'd up into Ice.

XV.
Hot Fountains do not receive their Heat from subterraneous Fires.

Supposing, according to what hath been deliver'd before, that the *Earth* contains great store of *Brimstone*, *Jews-Lime*, and other inflammable Bodies, it will not seem strange to us, that *Hot-waters* or *Bathes* break forth in several places of the *Earth*. Nor is it necessary that these Bodies should be actually set on fire, in order to heat the water flowing by them: For it doth not seem probable, that any such matter should be able to flame in the *Earth*; because the Smoak of it would soon choak it for want of vent, or the surface of the *Earth* must burst to give it Air. Wherefore it seems more likely, that as of *Saltpeter*, *Brimstone*, *Jews-Lime*, and *Quick-Lime* Mixtures are made, which by sprinkling water upon them, do grow hot (which happens also to *Aqua Fortis* and Oil of *Tartar*, and to *Butter of Antimony*, and Spirit of *Nitre*, when put together;) so the like Mixtures may be under the *Earth*, and the same Heat may happen when any Moisture comes to them.

XVI.
But from a Mixture of Heterogeneous Bodies.

For it is not always necessary that *Hot Fountains* should proceed from *subterraneous Fires*, seeing that a mixture of *Heterogeneous Bodies* is sufficient for this purpose, as being able by Fermentation to produce the same effect. Heat therefore is communicated to *Hot Bathes*, whilst their water passeth through Channels heated by the fumes from *Jews-Lime*, *Brimstone*, or the like. For the water, by passing through these *Hot places*, becomes heated thereby, after the same manner as when water is heated in a *Stove*.

XVII.
The Qualities of Water.

Accordingly, if the water of *Fountains*, before it breaks forth on the surface of the *Earth*, happen to pass through Juices and Minerals, it acquires from them their Taste and Smell, and several other qualities. For the strong Scents of some waters are from *Brimstone* and *Jews-Lime*, their Bitterness, from *Nitre*; their Acidity from *Copperas*; their Harshness and Adstringency, from *Alom*; their Saltiness, from *Common Salt*; their sharp Taste, from *Marchasite* or *Fire-stone*; their Iron taste, from *Iron*.

XVIII.
Waters receive their Medicinal virtue from the Mineral Juices, through which they flow.

And forasmuch as those Juices through which these waters flow, abound with a Medicinal virtue, 'tis from them that they derive it, and by means thereof are profitable for the Cure of many Diseases. The Purgative virtue that some have being chiefly owing to *Brimstone*, *Salt*, or *Nitre*; the Adstringing faculty of others to *Alom*, which is made use of by Physicians against *Ulcers*, *Bloody-fluxes*, and *Relaxations* of the Nerves. Those Waters that have a power of mollifying the *Earth*, receive it mostly from *Brimstone* and *Jews-Lime*. Which is the Cause why *Bituminous Bathes* are accounted profitable to those who are troubled with the *Gout* or *Ach* in their Hips. In like manner Waters are made hurtful, by being imbued from some *Metallick Bodies*; such are those which have received a taint from *Lead*, or *Quicksilver*,

or are infected with a petrifying Juice, or of some middle Mineral, as that of *Antimony*; and therefore causing Vomitings, and Scourings. And, in a word, whatsoever Waters exert any special Operation on the Body of Man, have it derived from *Subterraneous matters*.

CHAP. XII.

Of the Ebbing and Flowing of the Sea.

BY the *Sea-Tide* we understand the Ebbing and Flowing of the Sea, which twice happens in the time of 24 hours, and about 50 minutes. The *Sea-Tide* is Regular, tho' it do not happen at the same time, nor after the same manner in all places. For the Sea swells as oft as the Moon passeth our Meridian, whether above or under our Horizon; and it falls again, when the Moon is on the Horizon, whether it riseth or sets: For we find, that the Sea in its motion keeps a proportion of Time with the Moon; for as the Moon riseth every day 3 Quarters of an Hour and 5 Minutes later, so at the same Interval doth the Sea rise.

For the Flowing of the Sea is nothing else, but the motion of the Sea-water towards the Shoars, in about Six Hours time: And the Ebbing, is the motion of the said Waters from the Shoars, seaward, in other Six Hours time.

The Tide is not the same in all Seas; but in some the same is greater, and in others less, yea, in some the Tide is very inconsiderable, or none at all. In some places the Flowing of the Sea, is equal to its Ebbing, in others greater and in others less. The greatest variety of Tides is at the *Aequinoxes* and *Solstices*, as also at the different Aspects of the Moon: Thus at the Full and New Moon the Tide runs highest, as it is least at the Quarters. This is observ'd in almost all the Shoars of Europe, which the Ocean beats upon. But the Flood is always so much the greater, and comes the slower, by how much the Shoars against which they beat, lye more towards the North; and on the contrary is scarcely sensible between the Tropicks.

The Ancients, to give a Reason of all these Appearances, feigned the World to be a great Animal, which by breathing through its Nostrils, placed by them at the bottom of the Sea, did cause the Sea to rise and fall. But this Monster is long since vanish'd into a Chymara. Some of the later Philosophers, Peripateticks, and others say, that this Reciprocation of the Sea proceeds from an Occult quality. But what is this else, but a Profession of their Ignorance, and that in plain terms they do not know the Thing they pretend to Explicate? At this rate, it is an easie matter to explain all the Mysteries of Nature. For that which is hid is not known; and indeed we know no Effects, but such as we can demonstrate by their proper Causes.

Some attribute this Effect to the Agitation of the Saline particles of the Sea-water, by the moderate heat of the Moon. GALILEUS, to the multifarious and unequal motion of the Earth. But these their Opinions are overthrown by this Observation, that neither of them gives the least probable Reason of these motions in the upper Hemisphere.

I.
The Ebbing and Flowing of the Sea is proportion'd in time, according to the Motion of the Moon.

II.
What the Sea-Tide is.

III.
The Tide is not the same in all Seas.

IV.
The Opinion of the Ancients, and some of the Peripateticks, concerning the Cause of the Sea-Tide.

V.
The Opinion of Galileus, and of some others.

Hemisphere, when the Moon is in the lower ; and on the contrary. The latter Opinion is indeed the better of the two, but somewhat obscure , and not altogether consonant to Reason ; because it attributes less to the Moon than her due, who certainly hath a great stroke in this matter.

VI. Some things supposed for the better understanding of the Sea-Tide.

For the understanding of the true Cause of the Sea-Tide, some things are to be presupposed.

First, That the Course of the Moon, and of the rest of the Planets is Elliptical , not perfectly Round. And this is granted by all who suppose the Heavens to be fluid.

Secondly, That whilst the Earth is whirl'd about from West to East, in the Center of her Vortex A B C D, the Moon is carried in the outward Surface or Circumference of the said Vortex, and in a Months Space absolves her Course.

Thirdly, That when the Moon is plac'd at B, the Heavenly matter will be more strong between B, and 6, than between 8 and D ; because it there flows through a narrower Space, by reason of the Moons presence ; and therefore the place of the Earth, which is determin'd by the force of the Circumfluent matter, will also be changed, that is, the Earth will withdraw towards D, till the force be equal on both Sides.

VII. The true Cause of the Sea-Tide.

These things presuppos'd, let us consider the Figure where the Elliptick A B C D represents the Vortex of the Earth, in the midst whereof the Earth E F G H is placed. The Circle B C, the Globe of the Moon ; 1 2 3 4, the surface of the Sea ; and 5 6 7 8, the Air, which surrounds the Sea. This suppos'd, we may easily understand that the Rising and Falling of the Sea must proceed from the presence of the Moon. For seeing that all places are fill'd with Bodies, and that the same portion of Matter is preserv'd every where ; it follows that New Bodies cannot be admitted into them, except thereby other Bodies be compressed, so that they that come in must thrust the others out of their places, and force them to betake themselves elsewhere. Which happens here by reason of the Lunar Globe B C ; for the Moon being a great Body, and requiring a large Space to dilate it self in, she cannot ascend upon our Horizon, without lessening the Interval that is betwixt her and the surface of the Earth, and by this means forcing the Celestial matter to flow more swiftly ; and consequently pressing as well the surface of the Air 5 6 7 8, as that of the Water 1 2 3 4 the more, which being fluid Bodies, do readily yield to the said pressure.

VIII. An Objection answered.

It is of no weight, to say that the Air and Heavenly matter move more slowly in the great Diameter, even then when the Moon takes up a part of it, than they move in the little Diameter, when the Moon is without the same : For it is enough, if the passage only of the Air and Celestial matter be more straitned in the great Diameter, when the Moon is in it, than it is when she is not, to cause the Waters that are in this Diameter to be driven towards the Poles, and so by this means to cause an Ebbing and Flowing.

IX. The presence of the Moon presseth the Water and the Air in

Forasmuch therefore as it is manifest, that the Earth E F G H is kept in, and determin'd to the same place, by the equal pressure of the subtil Matter that surrounds it ; it cannot be conceived, how that part of the surface of the Earth, which is opposite to the Moon, existing in the Point B,

should be more pressed, without conceiving at the same time, that the Matter of the Heaven must push the Earth out of its place, thrusting it forwards to the opposite part D, until the Earth, about the Point 8, be pressed after the same manner, as about 6. Wherefore there are two streights, B and 6, and D and 8, made in this Vortex or Heaven, which are diametrically opposite to each other, viz. the one betwixt the Moon C, and the Earth T ; and the other between the Earth T, and D.

Whilst therefore the Celestial matter, which moves round about the Earth, moves more swiftly in these Streights, one whereof is betwixt the Earth T, and the Moon B ; and the other betwixt the same Earth T, and the opposite part D. It presses the Sea 2 and 4, and drives it from thence towards those places that are free from this Pression, that is, towards G and E ; where swelling by the force of its own Heaviness, it is driven towards the Shoars.

And because the Circumvolution of the Earth about its own Center, is performed in 24 Hours, if we divide its surface into Four parts E F G H, that part of it which is at F, where the Sea is lowest, because of the presence of the Moons Body, 6 Hours hence will be in G, over against the Point C. where it is highest ; and after 6 Hours more at H, and soon. Whence it follows, that the Sea-water must of necessity flow and ebb every 12 Hours, in one and the same place. And because the Moon every Day runs 12 Degrees towards the East, the Tide must be retarded, that is, come later by almost an Hour : For tho' the Earth be carried about in 4 Hours, and must at a certain time bring back the same part of the Ocean ; yet because it must also run over those 12 Degrees, which the Moon hath run through before it can bring back that part of the Ocean, and oppose the same to the Body of the Moon, so it is that the Tide happens every day about 50 minutes later ; and consequently between the two Tides that happen every day, there is the difference of 25 minutes.

It is easy to apprehend, that if the Earth and Moon were immovable, the Waters that have been prest towards the Poles, would not return from thence ; forasmuch as they would be held there by the same Cause that hath push'd them thither. But seeing that the Earth and the Moon are in a perpetual motion, it will follow of necessity, that the Waters which have been thrust from the Parallel which is under the Moon towards the Poles, must return afterwards by their own weight, from the Poles towards the Parallel, above which the Moon is, at that time when the parts, from whence they have been driven, are no longer opposite to the Moon.

It is apparent also, why the Tide must come later to the Northern Shoars, than to those that are further from the North ; for seeing that the moved Waters are driven from the South part to the North, they must of necessity reach the nearer Shoars before those that are further off : And because the Waters that beat the Shoars near to the Torrid Zone, may pass further and flow toward the Poles, except they be hindred by the Northern Coasts, it comes to pass by this means, that the Tide is greater and more sensible in that part which is at a greater distance from the Equinoctial Line ; because the Waters about the Equator,

two several parts.

X. How the Flowing of the Sea is caused.

XI. The Sea-Tide must happen twice in a day.

XII. Why the Waters return to the Parallel above which the Moon moves.

XIII. Why the Tide is longer in coming to the Northern parts, and therefore is greater there.

G g g

quater,

XIV.
An Obje-
ction an-
swer'd.

quator, by reason of the largeness of the Circle, are diffused towards the Poles, that they may be gather'd together in a narrower Region.

But if any one Object here, That the Waters, in the space of 6 Hours, which is the time of the Duration of the flood, cannot flow from the Tropick to the Poles; and thence conclude, that the swelling of the Sea towards the Northern parts, cannot be an effect of the pressing of the Moon betwixt the Tropicks. I answer, That in order to make the Sea swell towards the North, it is not necessary that the Waters, betwixt the Tropicks, should go to the Poles; but that it is sufficient, if they only drive away those that are nearest; and that these again drive others before them, and so on to the last; which may be done in less than 6 Hours time, because the Sea is a continuous Body.

XV.
Why the
greatest
Tides are
about the
Equinoxes.

Now the Body of the Moon continuing of the same Thickness, takes up more of the narrow Space, when she is in the less Diameter, than she does of the larger Space, when she is in the greater Diameter; and therefore it matters not whether she be in her farthest distance from the Earth, or in her nearest; because at either time she makes the Space of the Vortex wherein she is straighter or more narrow; and it is only her presence over against the Earth that is the Cause of the Tide, and not her nearness to it. And this furnisheth us with the true Reason, why the highest Tides are at the Equinoxes; because at the Beginnings of Aries and Libra, the Moon more directly acts upon the Earth, and presseth it accordingly, forasmuch as its Plain at both those times doth not decline from the Plain of the Equator of the Earth, above 5 Degrees. For then the middlemost part of the Earth, or the Equator, is in the Ecliptick, near to which the Moon always continues; and consequently the Space being there narrower, the pressure must be so much the greater. But at the time of the Solstices, she declines 23 Degrees and 30 Minutes from the Plain of the Earths Equator. Seeing therefore that from the former direct Opposition, doth follow a great Pressure of the Air and Water, it is no wonder if about that time the greatest Tides do happen.

XVI.
Why the
Tides are
greater at
New and
Full Moon,
than at
the Quar-
ters.

So likewise it is manifest, why the Tides at New and Full Moon are greater, than at the Quarters. For the Vortex ABCD, wherein the Moon is, is not exactly round, but somewhat Elliptical, and leaves a greater Space betwixt the Earth and its Circumference, about A, and C, than about B, and D. And therefore seeing the Diameter, wherein the Moon is when she is New or Full, is narrower than that which intersects it at right Angles, it must follow, that when the Moon is in those narrower streights of Heaven, she must with more force press the interfluent Matter, and consequently produce greater Tides. But in the Quarter of the Moon about A and C, the Tides are less; because the Moon is then in those more ample Spaces, and consequently there must be a less pressure of the Waters.

XVII.
An Obje-
ction an-
swer'd.

It signifies nothing therefore to say, that the Moon is not always nearer to the Earth, when she is in Conjunction or Opposition, than when she is in her Quarters; and that consequently the Tides ought not to be greater at the Conjunctions or Oppositions, than at the Quarters: Because, as I have before observed, the highest Tides do not precisely depend upon

the Moons being nearer to the Earth; but because at the Conjunctions and Oppositions the Moon is always in the least Diameter of the Ellipsis; where, whensoever she is, be she nearer to, or further from the Earth, she always more straightens the passage of the Air and Heavenly matter, than she doth when she is in the greatest Diameter of the Ellipsis.

The greatest Floods commonly happen 3 days after the New and Full Moons, because of the Disposition the Sea-water is in at that time, to be moved more than ordinary: For having been strongly moved the two foregoing days, it is no wonder to find the Tides still to increase for 2 days after that the Sea hath received its greatest Impulsion from the Moon.

It remains still to be explained, how it comes to pass, that seeing the Moon is the common Cause of all Tides, there is a great variety of them to be observed in the Ocean. To clear this Difficulty, I say, that this variety of Tides is often to be attributed to the Sea-shoars, which according as they are nearer or more remote, so the Waters reach them sooner or later. Wherefore, if the Sea about the Aquitain shoar flows 7 Hours, and ebbs but 5; and on the contrary, if near Canada, it flows 5 Hours, and ebbs 7; if on the shoars of Guinea in Africa, it flows 4 Hours, and ebbs 8. If at Venice the Tide rises many Foot high, and at Ancona nothing at all, or very little, this depends on the diversity of the situation of those Coasts. Of this we have an Instance in the Banks of Rivers, between which, according to the difference of their situation, the Water runs either headlong, or glides away smoothly; runs winding and turning, or takes a strait course. The Aquitain Sea therefore is longer a flowing, than it is ebbing; whereas on the Belgick shoar, the Flood and Ebb is equal, because of the different degrees of their Steepness and Declining. So likewise at Venice, and on the Coast of Syria, the Tide riseth much higher than with us; because the former places are situate, as it were, at the end of the Channel; whereas the latter are in the midst of it: For it is manifest, that the rising or falling of the Water shaken in a Vessel, is only perceived at the Extream parts of the Vessel; whereas in the Middle there is nothing to be perceived, but an equal and simple flowing of the Water.

But to determine something more particularly about this Diversity of Tides, we are to take notice, that the motion of the Waters chiefly depends on this, That in that vast Tract of the Sea, there be some peculiar places where the Waters are very much pressed, because of the Moons presence; and others again, where no force at all seems to be put upon them: Which makes that the Waters are driven to those places where there is no pressure, and so arise there against the Shoars, and make a Flood. Wherefore, if there be any Waters in the Sea, which because of the inconsiderableness of their Extension, are all over cover'd by the Body of the Moon, they must needs be so equally press'd in all their parts, as that no Rising or Falling can be perceived in them. Thus those Lakes, Pools, and Rivers that are between the Tropicks, have no Tides, seeing that because of the smallness of their surface, compar'd with the Bulk of the Moon, they cannot be sensibly press'd one way more than another. Wherefore

XVIII.
Why the
greatest
Tides are
three days
after the
New and
Full Moon.

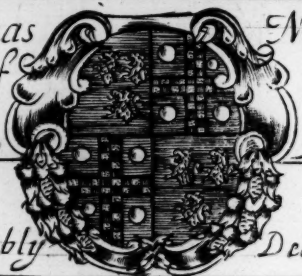
XIX.
The Cause
of the
various
Tides in
the Sea,
proceeds
from the
different
situation
of the
several
places.

XX.
And how
the variety
of the
Tides
depends
on the
situation
of the
Moon.



To Captaine Thomas
in the County of

Newman of Iwer
Buckingham Gent.



This Plate is humbly

Dedicated by Ric: Blome

XXI.
Why some
Seas suffer
no Tides.

Wherefore it is no wonder, if in the *Baltick Sea*, the *Dead Sea*, and the *Euxine Sea*, no *Tides* at all are perceived; because those *Seas* have no intercourse with the *Ocean*; or if any of them have any communication with it, it is by such narrow passages, that the agitation of the *Sea* can have no great force upon them.

XXII.
The meeting
of Waters,
a Cause of
the difference
of Tides.

To this Diversity of *Tides*, the various Meetings of *Waters*, and difference of *Winds*, which differently agitate them, and drive them one against another, do much contribute. For the *Sea* flows continually from *East* to *West*, which those who sail from *Spain* to the *West Indies* have Experience of; for they frequently perform this Voyage in 30 Days; whereas in their Return, they spend no less than 3 Months, because the Course of the *Sea* is against them, and runs *Westward*. And the same is observ'd by those who sail from *Lisbon* to *Brazil*.

XXIII.
Why the
Gulf of
Venice
flows to-
wards the
West.

If you Object, That the quite contrary to this is found in the *Gulf of Venice*; for the *Sailors* tell us, that when they are over against *Epirus* and *Dalmatia*, they perceive that the *Waters* are carried with a strong Stream *Westward*, towards *Venice*; and that when they are near the Coast of *Italy*, they are carried *Eastward*, towards the *Morea*. I Answer, That these motions of the *Waters* are caused by *Rivers*, which from *subterraneous Cavities* flow into the *Sea*; which in their coming forth, do with great Violence push forwards the water of the *Sea* that meets them, and divert it from its Course. Or else those *Rivers*, being beaten back by the *Water* of the *Sea*, are forc'd to turn their motion, and to run another way.

XXIV.
An Obje-
ction
against the
foregoing
Explica-
tion, of the
Ebbing and
Flowing
of the Sea.

But against this Explication of the *Ebbing* and *Flowing* of the *Sea*, it is Objected, First, That if the *Moon* did drive the *Waters* from between the *Tropicks* towards the *Poles*, it would follow, that when the *Moon* is in the *Meridian*, it would be *Low-water* in that part which was opposite to it, and *High-water* towards the *Poles*; whereas Experience shews the contrary, viz. that the *Tide* comes in when the *Moon* approacheth to the *Meridian*, and that the water falls, as she withdraws from it.

XXV.
Answer'd.

I Answer, That when the *Moon* is in the *Meridian*, the *Sea* must be low precisely in that place which is over against it; but it doth not follow therefore, that it must be *High-water* under the *Poles*, but only that it must be *High-water* between the *Tropicks* and the *Poles*, and so it is. For we find by Experience, that the *Sea* increaseth from about the *Tropicks*, to the most Northern part of *England*; and that from thence, towards the *Poles*, it increaseth no more. Whence it is, that in the *Northern Ocean*, from about the *Latitude* of about 65 Degrees, to the *Poles*, there is no *Flood* nor *Ebb* at all.

XXVI.
A second
Objection
against
this Expi-
cation of
the Tide.

In the Second place it is Objected, That the *Celestial matter* which follows the *Moon*, and which moves somewhat swifter than she doth, from *West* to *East*, doth not only run under the *Moon*, but also above it, and on the sides of it; so that that part of the *Sea*, over against which the *Moon* is, will be no more pressed than the rest.

XXVII.
Answer'd.

For Answer: It is certain that the *Heavenly matter* which follows the *Moon*, and is in a ten-

dency to go somewhat swifter than she doth, from *West* to *East*, doth not all of it flow under the *Moon*, but that a part of it passeth above it, and on the sides of it; yet doth not this hinder, but that the *Way* of the said matter under the *Moon* is more *streightned*, which is sufficient to make the *Sea* to be more pressed in that part, than in all the rest.

From what hath been said, we may gather, that there is a *Threefold Tide*, according to the difference of Times, viz. a *Daily*, *Monthly*, and *Yearly Tide*.

The *Daily Tide* is that, whereby the *Sea* in 24 Hours time doth twice approach to the same Shoar, and as many times retires again in this order, That the *Tide* of the *Day* following falls about 50 minutes later, than that of the *Day* foregoing.

The *Monthly Tide* consists in this, that the *Daily Tide* increaseth twice in a *Month*, viz. about the *New* and *Full Moon*, and twice decreaseth, viz. in the *Quadrant Aspects* of the *Moon*.

The *Yearly Tide* consists in this, that the *Monthly Tide* twice in a *Year* riseth higher than ordinary, viz. at both the *Aequinoxes*, and as often decreaseth, viz. at the *Solstices*. Wherefore if these 3 Periods be compared with the *Daily* and *Yearly motion* of the *Earth*, it will seem impossible, they are the words of *GALILEUS*, in the 4th Dialog. *System. Mundani*, That Naturally there should be any *Tide*, supposing the *Earth* to stand immovable, without betaking ones self to the absolute Power of *GOD*, and conclude, that the *Sea-Tide* is a *supernatural Effect*.

CHAP. XIII.

Of the Air.

THE AIR, according to the Order of Nature, follows the *Earth* and *Water*, to the *Surfaces* whereof it adheres and is joyned. The *Astronomers* call that part of *Heaven*; *Air*, into which the *Vapours* and *Exhalations* ascend. And because all those *Exhalations*, which are continually breath'd forth from the *Earth* and *Sea*, are by the pressing of the *Subtil matter*, dispos'd into a Round surface (at least as far as the agitation of those *Bodies* will permit) they gave the Name of *Atmosphere* to those *Vapours*. It is various, according to the diversity of *Heat* and *Cold*, and of the *Vapours* themselves; and from thence proceeds a various *Refraction* and *Reflexion* of the *Rays* of the *Sun* and *Moon*, and the other *Stars* in the *Air*.

Accordingly we are to distinguish a twofold Substance in the *Air*, viz. one *Native* and *Primitive*, which hath been from the Beginning of the *World*, and which is the most pure and thin part of it: And the other *Adventitious* or *Foreign*, which consists of the *Effluvia's* or *Stems* of other *Bodies*, according to the difference of *Place* and *Time*. Hence the *Air* is accounted, First, absolutely Pure, when these *Stems* are not so thick, that they can easily cling together, and thereby lose the form of *Air*. Secondly, With respect to us, whilst those *stems* are not so hurtful to our *Bodies*; such as they are at the time of *Epidemical* and *Contagious Diseases*.

XXVIII.
There is a
threefold
Tide.I
Of the
AtmosphereII
There is a
twofold
Substance
in the Air.

The

III.
What the
Air is.

The Air is a loose Body, fluid and transparent, whose Particles are so small, and so little clinging together; that they may with the least force be separated from the Globuli of the second Element and by a peculiar motion be carried independently about their own Center. The Fluidity of the Air proceeds, from its being compos'd of very subtil and thin Particles; for tho' their irregular Figures seem to dispose them to cling together, yet are they forced to continue separate, because the minuteness of their Branches makes them yield to the motion of the Subtil matter, which by its great Mobility keeps them disunited, and makes them continue in a Liquid form. And forasmuch as its Particles are thin and disjoyned, every one of them moves independently from any of its Neighbours, and takes up that whole little Sphere, which is needful to its being whirl'd about its own Axis, keeping all other particles out of it.

IV.
The Property of the Air is to Polish and Smooth.

The Air's Property is to polish and smooth moist Bodies, and to keep them from being easily penetrated; as appears in the Water, which easily bears a Steel Needle, or a Pane of Glass, as long as its surface is not broken. Now the Cause of this is, because the Parts of the Air are moved otherways than the Parts of the Water; so that by their rubbing against one another, both their surfaces are hardened, and made more unfit to be divided.

V.
What Vapours and Exhalations are.

But because the more subtil parts of Exhalations do compose the Air, it will not a little conduce to our better understanding of the Nature of the Air, if we explain what Exhalations are, and how they are distinguish'd from Vapours. Vapours therefore are nothing else, but Particles of Water, which the Heat of the Sun, and the Circular motion of the Earth, have separated from one another, and raised into the Air. And, Exhalations are certain Particles, which by the same Causes have been separated and raised from Earthly Bodies.

VI.
How they are said to be raised by the Sun.

When it is said, that Vapours and Exhalations are raised into the Air by the Sun, it is not so to be understood, as if the Sun did attract them by his Beams (for such an Attraction is unintelligible) but only that at the presence of the Sun, or some other Cause, the Subtil matter which pierceth the Pores of Bodies, doth separate some Particles from them; which finding no other place but the Air, wherein they can move, do tend that way, in a manner not much unlike to that, whereby the Dust, which in Summer time we tread upon with our Feet, mounts upwards, and is raised up into many Clouds, according to the number of those that Tread it.

VII.
Another Property of the Air, is to be Rarefied and Condensed.

The Air, and all Vapours, are easily condensed and rarefied, according as they are more or less agitated. They become Rarefied, when they are more swiftly than ordinary tossed by the Heat: For seeing their Particles are flexible, the least commotion doth dilate them, and then they require a greater Space to continue their motion in. Again, they become Condensed, when they cease to be agitated by Heat; for then their Particles cling together, and are compressed by Cold: For nothing else can be understood by Heat, but the Agitation of the minute Particles of Bodies; as by Cold, the Diminution or Cessation of that motion.

VIII.
The Air being compressed.

The Air that is forceably compressed in any Vessel, hath a power of springing back (which is

called its *Elastick virtue*;) and of extending it self into a larger space. By which means Instruments are made, which, with the help of the Air only, drive the Water upwards, as we see in Artificial Fountains; and others, that shoot Darts, like Bows. The Cause whereof is, for that when the Air is thus compressed, each of its spherical Particles hath not sufficient place left it, wherein to perform its Circular motion, by reason of the crowding in of other Bodies: And forasmuch as at the same time, the agitation of these Particles is continued, by the motion of the Heavenly matter perpetually flowing about those parts, it can be no otherwise, but they must hit against one another, and push each other out of their places; and thus at last, all of them together, make a strong push for it, to acquire a larger space.

Condensed Air is more heavy, than that which is Rarefied; because it contains less Heavenly matter. We may Experience this, by filling a Bladder first with a little, and rarefied Air; and afterwards with much, and condensed Air.

From the Greater or Lesser Agitation, or Rarefaction and Condensation of the Air, we conclude, that the Compass of the Air is greater in Summer than in Winter; and therefore that what is commonly said, that the furthest distance of the Air from the Earth is of 52 Italian miles, is vain and uncertain. And the same is to be said concerning the three Regions of the Air, and their several Bounds; as when they ascribe to the Lowest Region, the height of half an Italian mile; to the Middlemost, of three and an half; and to the Higheft, the height of 48 miles. For seeing there are no certain Bounds whereby these Regions are discriminated, it is a Fond undertaking, to go about to determine their Limits.

Another Property of the Air is *Heaviness*. For as we find that the Water presseth the bottom it lies upon; so likewise the Air, which encompasseth the Earth, doth press it on every side; and so much the more vehemently presseth it, by how much it is nearer to the Earth: As appears in a Bag-Pipe or Bladder fill'd with Air, which thereby becomes heavier than it was before. The same also may be proved, by the running of Quicksilver out of a Pipe that is stop't at the Top; for the Quicksilver changeth its height, according as it is carried along a low, or high place; so as to be depressed deeper in a high place, and mount up higher in a low place.

If you demand, How comes it then to pass, that we are not sensible of the weight of the Air? I answer, That the Reason is, because there is as great a Force in our Body to resist, as there is in the Heavy Air to press. For our Body being full of Blood and Spirits, doth with no less Force resist the pressure of the surrounding Air; which is the Reason, why the Air with its weight cannot move our Nerves, nor impress a sense of Heaviness upon us.

Now the Heaviness of the Air, is to be ascribed to the watry Particles that are mingled with it; because that part of it which is diffus'd about the Earth, and reacheth to some certain distance, doth approach to the Nature of a watry Vapour, especially when many Steams are mix'd with it. Yea, if we may believe some Men, Thick Air is not only

press, hath the power of springing back.

IX.
Air condensed is more heavy than that which is rarefied.

X.
The Distance of the Air from the Earth, is uncertain.

XI.
The Air is heavy.

XII.
Why the weight of the Air is not felt.

XIII.
Whence the Heaviness of the Air proceeds.

only fill'd with *Steams* from the *Earth* and *Water*; but receives also the *Breathings* of all other *Bodies*, and abounds with their *Spirits*.

XIV. Why the Lower Region of the Air is hotter than the higher.
The *Region* of the *Air*, which is nearest to the *Earth*, is hotter than that which is at a good distance from it; because the *Solar Rays* being more copiously reflected from the compact *Body* of the *Earth*, do produce a greater agitation of its *Particles*. And therefore it is that the higher *Regions* of the *Air* is cold, where *Clouds*, *Snow* and *Rain* are generated; because the *Rays* that are reflected from the *Earth*, do not so copiously mount up to it.

XV. The Air is not Moist, as the Peripateticks suppose.
The *Peripateticks* hold the *Air* to be *Moist*, but without any sufficient ground, that ever I could understand; save only, because they thought it convenient to attribute two of their invented *Qualities* to the *Air*, which they call an *Element*. For tho' the *Air* be sometime called *Moist*, this doth not suppose it to have an *Essential Humidity*; but is so denominated, because of those *Watry Particles* resolv'd into *Vapours*, that are joyn'd with it; which, when they are removed, it is called *Dry*: In which condition it cannot be turn'd into *Water*, no not by the most extream *Cold*.

C H A P. XIV.

Of the Elastick or Spring like Force of the Air.

I. What a Spring is.
BY the word *SPRING* is commonly understood, that whereby a thing that is forceably bent and reduc'd to a less Extension, doth explicate it self again, and strive to return to its former Expansion.

II. Wherein the Elastick or Spring-like force of Bodies doth consist.
This *Elastick*, or *Spring-like Force* in *Bodies*, proceeds from the *Subtil* or *Ethereal matter*; for when any hard *Body*, by Example, the *Blade of a Sword* is bent, its parts are by this means deflected from the *Convex* or *Jetting-side* of the *Blade*, and approach nearer on the *Concave* or *Hollow-side* of it; by which means the *Pores* on this side, must needs be made more narrow. Now because the *Subtil Matter* cannot exert its Force, to return through those parts of the bended *Body*, it passeth through; but strives at the same time, to reduce the parts thereof to that state wherein they were before, it must necessarily follow, that this *Body* must fly back.

III. The Air is easily Condensed and Rarefied.
This Affection is most peculiar to the *Air*; which being nothing else, but a company of thin *Particles* of the third *Element*, which comply with the motions of the *Heavenly matter*, becomes easily condens'd; not only when by the decrease of *Heat*, and the less agitation of its parts, they do not with so great Force push against one another, as before they did; but also because they are shut up within the parts of another *Body*, which compresses them more than ordinary. And on the contrary, the *Air* is as easily *Rarefied*, as soon as those Causes are removed, which reduc'd it to a less Space. Whether this happens by means of *Heat* let into its *Pores*, if before it was condensed by *Cold*; or by opening the *Prison* wherein it was shut up before, if by *Compression* only it was reduced to a less Bulk.

For the *Air* can be dilated three several ways, either by its *Elastick virtue*, whereby it resists its being Comprest; or by the Force wherewith the *Subtil matter* strives to enter again into the *Pores*, whence it hath been driven away; or, lastly, by the extream Agitation of the said *Matter*, which moving the parts of the *Air* more strongly than ordinary, causeth it to extend it self farther. And on the contrary, the *Air* becomes condensed, either because it is pressed; or, because the *Subtil matter*, which before moved its *Particles*, is slipt away from them; or, because the said matter having lost part of its Agitation, hath no more the Force to move them as much as it did before, which makes them to lye more close together.

But we are to take notice, that this *Dilatation*, whereby the *Air* removes all Obstacles that compress it, is and must be very sudden; because its parts, which before could not move without clinging together, do then with joynt Forces leap back, and by the force of the *Heavenly Globuli*, continually flowing about them, make an assault together, in order to take up a larger Space. There are various Experiments that are founded on this Affection of the *Air*, which we admire in *Artificial Fountains*, and *Wind Guns*, which shoot *Leaden-bullets*, and other things.

For let the *Air* be comprest in the *Pneumatick Vessel*, the lower part of it being fill'd with *Water*, and the *Water* will spout out thence with so great force, that it will surpass almost any supposed height. For Example, Let the *Pneumatick Vessel* be *A B C*, the lower part whereof *B C* contains *Water*, and the superiour *B A C* *Air*; which being crowded into it by the *Pipe A D*, at several times; let it be comprest, as is wont, in the upper *Cavity B A C*; then let the *Tube* or *Pipe A D* be well stop't, by turning the *Key* of the side *Pipe*, appearing above *B*. This supposed, if the *Key* of the greater *Pipe D A* be open'd, the *Water* will spout forth through the said *Pipe* with great force to *E*, being forc'd upwards by the comprest and condensed *Air*. And forasmuch as the *Air* is still capable of greater degrees of *Compression*, it is certain that the *Air* may also be push'd upwards with still greater and greater force.

The Reason of this Experiment is this, that the *Particles* of *Air* contained in the *Pneumatick Vessel*, being thin, and separate from each other, do yield to the motions of the *Globuli* of the second *Element*: But when these *Globuli* are by some force thrust out, the *Particles* of the *Air* are forc'd to come nearer together, and entangle one another, so as that they can no longer whirl round, as they were us'd to do. Now being toss'd about by the *Subtil matter*, they with their *Corners* hit one against another, and thrust each other out of their place: By which means they so bend their Force, to get more room for themselves, as that by that Effort they spout out the *Waters* with great force towards *E*.

And for the same Reason a strong *Wind* can be excited, by means of the *Compression* of the *Air*, which will be able to express all Variety of *Sounds*. For so we Experience, that even great *Organs*, by the *Pneumatick Art*, can play variety of *Tunes*, without any assistance of a *Musicians Hand*, to wit, by our blowing into some *Pipes*, and thereby turning a *Wheel*, whose

H h h

Teeth

IV. The Air can be Rarefied and Condensed divers ways.

V. The Action whereby the Air flies back like a Spring, is very sudden.

VI. An Example of an Artificial Fountain.

Figure 47.

VII. Musical Wind-Instruments may be play'd upon by the Compression of the Air.

VIII.
How the
Wind-Gun
can dis-
charge
Lead-
en Bullets.

Figure
48.

IX.
The Com-
pression of
the Air
raiseth
Quicksilver
two Foot
high, and
keeps it so
suspended.

Figure
49

X.
The Air
proved to
be the
Cause of
this Effect.

XI.
This Sink-
ing of the
Quick-
silver doth
vary ac-
cording to
the differ-
ence of
Places.

Teeth shall tuneably strike the Keys of the Organ.

As for the *Wind-Gun*, which by means of *Air* only doth discharge *Bullets* with an extraordinary Violence, the same may be made after this manner. Suppose C A, in the *Figure*, to be a *Brass Pipe*, or *Bore*; and let the end thereof, marked A, be well stopp'd, and be furnish'd with its Stock, and with two Keys I and K, so as that one of them may touch the other; and having open'd both the Keys, let a *Plug* be put in at the Mouth of the *Bore* C, by the help of a *Screw*, the Operation being several times repeated, in order to a stronger Compression; then let the Key K be shut home, and the other Key I be a little open'd, that by letting in of *Air* the *Plug* may be drawn forth; then let a *Bullet* be put into the *Bore*, with a little *Tow*, to keep it in; then open first the Key I, and afterwards K, and there will follow a forceable explosion or discharge of the *Bullet* at a great distance, by force of the Comprest *Air*.

It is from the same Compression of the *Air*, that *Quicksilver* contain'd in a *Glass-Pipe*, open at one end and stopp'd at the other, remains suspended 2 Foot and a quarter high; whereas *Water* is rais'd to almost 32 Foot. For take a *Glass-Pipe* A B, 3 Foot long, being open at the one end A, and *Hermetically* sealed at the other B; let it be fill'd with *Quicksilver*, and turn'd upside down into the Vessel C D, also full of *Quicksilver*; it will clearly appear, that the *Quicksilver* will not sink down to the bottom of the *Glass*, but will continue suspended in the same almost 27 Inches high, at E. And the Reason is, because the *Quicksilver* cannot sink lower, but by pressing the *Ambient Air*, which being already condensed by that which lies upon it, and endeavouring to regain its former Expansion, strives against it, and by reason of the rowling of its complicated parts, cannot ply or give way. For tho' the *Quicksilver* be very heavy, yet can it not force the *Air*, consisting of thickish, vehemently extended, and continually rowling Parts, to a farther Compression.

Now that this Effect doth wholly depend on the *Elastic Power* of the *Air*, may be perceiv'd chiefly by this; because in the *Pneumatick Engin*, invented by Mr. Boyle, if the *Pipe* fill'd with *Quicksilver* be thrust into other *Quicksilver*, as soon as the *Air* is exhausted, the *Mercury* no longer continues elevated 27 Inches high, but sinks by degrees, and falls into the *Vessel*. But as soon as the *Air* is let in again into the *Engin*, the *Quicksilver* riseth again, and takes possession again of its former station.

Yet we find that the *Air* hath not the same Force in all Countries, nor resists the weight of *Quicksilver* alike; but according as the same is purer or more gross, so the linking thereof is different. For tho' the *Air* be a *Liquid Body*, and be so ranged about the Center of the *Earth*, that its surface is of a *Round Figure*; yet because about the Poles, by reason of the great Cold it is more condensed, than in other places, it must needs be found there in greater abundance; and consequently must lye more heavily upon the *Earth* of those Countries, than upon those that are nearer to the *Aequinoctial*. Upon which account it is, that the *Quicksilver* sinks less in the *Glass-Pipe*, in *Holland*, *Denmark* and *Sweden*,

than in *France*, where the *Air* is more thin and rarefied; and more at *Florence* than at *Paris*: So that in the Year 1643, in which this Experiment was first tried, the *Quicksilver* in a *Weather-Glass*, at *Florence* in *Italy*, stopp'd at 2 Foot and almost 3 Inches: At *Paris*, at 2 Foot 3 Inches and an half; and in *Holland*, at 2 Foot, and 6 or 7 Inches.

And not only so, but this Rising and Falling differs also, according to the Change of the *Weather*; for we find that the *Quicksilver* in a *Weather-Glass*, sinks more in *Fair* than *Rainy* weather, and on a high *Mountain*, than in a low *Valley*, or any other place, where the *Air* is more Thick and Gross, and so strives more against the weight laid upon it. For the *Air* is condensed according to the Proportion of the weight of the *Air* that is above it, which is always so much the greater, by how much the *Air* is lower; and consequently it is necessary, that this Virtue be greater in that part of the *Air*, which is nearer unto the *Earth*, than in that which is farther from it.

From this *Weight*, or *Elastic Power* of the *Air*, proceed all those motions which are commonly ascribed to Natures abhorrence from a *Vacuum*, and may be readily explained by it: For no other Reason can be given why the *Water* riseth in a *Pump*, but only this, because it is pressed by the *Air*, that is about it, and so tends thither, where there is either very little or no pressure at all of the *Air*, viz. within the *Bore* of the *Pump*, out of which the *Plug* is pull'd; as hath been explained in our *General Physicks*, by many Instances.

CHAP. XV.

Of Meteors in General.

WE come now to treat of those things that are generated in the *Air*, commonly called METEORS: Which are nothing else but certain various impressions made upon the Elements, exhibiting them sometimes in this, and sometimes in another Form. And because for the most part they appear on high in the *Air*, they have got the Name of *Meteors* from their Elevation.

METEORS are Threefold, viz. *Fiery*, *Airy*, and *Watry*, according to the Predominion of that Element, which is most conspicuous in them.

FIERY METEORS, are those that consist of a fat, sulphureous kindled Smoak. And these are various, according to the diversity of their Figure, Situation, Motion, and Magnitude. For when a Fat kindled Smoak appears in the form of a lighted Candle, wandring up and down, it is called an *Ignis Fatuus*, or *Will with the Wiff*: When it hath the appearance of a Cross Bar or Beam, it is called *Trabs*; when of a Pillar of Fire standing upright, it is called *Ignis Pyramidalis*; when its parts are of unequal thickness, the middle parts being thicker and broader, and the ends smaller, 'tis called *Draco Volans*, that is, a *Flying Dragon*; when the *Fiery Meteor* seems to skip like a *Goat*, appearing sometimes kindled, and at other times extinguish'd, it is called *Capra Saltans*, that is, a *Skipping Goat*. But the most wonderful and terrible

XII.
And of the
Weather.

XIII.
All the
Motions
that are
commonly
attributed
to the
avoiding
of a Va-
cuum, are
caused by
the Weight
of the
Air.

I.
What Me-
teors are.

II.
Meteors
Threefold.

III.
Fiery.



To y^e Honourable
Second Son to y^e
John Earle



John Granville
Right Honourable
of Bath &c.^a

This Plate is humbly

Dedicated by Richard Blome

terrible of all the rest are *Thunder* and *Lightning*, of which hereafter.

IV. *Airy.* AIRY METEORS, are those which consist of *Flatuous* and *Spirituos Exhalations*, such as the *Winds* are.

V. *Watery.* WATERY METEORS consist of *Vapours* or *Watry Particles*, by the *Action of Heat* separated from each other, and variously modified. These are manifold.

VI. *At Clouds, Snow, Rain.* For if these *Vapours* be elevated above the *Earth*, and hanging in the *Air*, are either by a *West-wind*, opposing the ordinary motion of the *Vapours* Westward; or by *Two other Winds*, blowing from different *Quarters*; or by the alone *Coldness* of the *Air*, condensed and joyned into some small *Icy particles*, *Clouds* are generated. If these *Icy particles* chance to be resolved by the *Heat of the Sun*, or of some *Wind* blowing from a *hot Quarter*, and the *Wind* driven together, do entangle with one another like *Carded-wool*, they make *Snow*; but if they be wholly melted into *Drops*, they constitute *Rain*.

VII. *Hail.* But when a *Cold wind* blowing congeals these *Drops*, when they are either altogether or almost dissolved, they become turned into *Hail*.

VIII. *Mist, Dew, and Hoar-frost.* If the *Vapours* hover near the *Earth*, they are called a *Mist*, which continues either till it be drawn upwards by the *Rays of the Sun*; or that by its own weight, or some other *External Cause*, it falls down to the *Earth*; where, by a less degree of *Cold*, it is changed into *Dew*, and by a greater, into *Hoar-frost*.

IX. *Appearing Meteors.* There is another sort of *Meteors*, which are called *Appearing*; such as are *Mock-Suns*, *Mock-Moons*, the *Meteor* called *Virgæ*, in the appearance of a *Fire-brand* or *Red*, the *Rainbow*, &c.

X. *A Mock-Sun and Mock-Moon.* What these are, and how they are formed, take this short account: When the *Extremities* or *Ends* of a *Snowy Cloud*, being dissolved by *Heat*, are by a supervening *Cold wind* constipated into thin *Ice*, and such a *Cloud* as this happens to be opposite to the *Sun* or *Moon*, then is the *Image* of either of them reflected in the said *Cloud*, as in a *Looking Glass*. That of the *Sun* is called *Parelius*, or a *Mock-Sun*; and the other of the *Moon*, *Paraselene*, or a *Mock-Moon*.

XI. *Virgæ, a Meteor in the form of a Bundle of Rods.* Again, when a *watry Cloud* is compos'd of *Parts*, whereof some are more close and compact, and others more loose and lax, and the *Sun-beams* chance to pierce the more lax and open parts of it, then it exhibits a *Meteor*, representing a *Bundle of Rods*, which the *Latins* call *Virgæ*.

XII. *The Rainbow.* Lastly, If a *Cloud* be resolved into small *Drops*, and the same be illustrated by the *Sun* plac'd over against it, then is form'd a *Semi-Circle* of divers *Colours*, called the *Rainbow*; whereof more hereafter.

CHAP. XVI.

Of Meteors in particular; and first, of the Winds, Clouds, and Mists.

I. *What Wind is.* WIND is a *Vapour* agitated and rarefied, which by passing from a narrow place, into one that is more large and wide, sensibly drives the *Air* before it.

II. *What is properly* The Name of WIND is improperly attributed to the Agitation caused by a *Fan* or a *Bellows*:

Neither can *Air* that is moved or rarefied by *Fire*, be called a *Wind*; seeing that the *Air* may be variously moved, when yet there is no *Wind* at all; as when *Drums* are beaten, or great *Guns* discharged. For we speak here only of a *Natural Wind*; which is nothing else, as hath been said, but an *Agitated Vapour*, which being distended, makes its way out of a narrower Space, wherein it was pent up, into a larger; and by this means sensibly driving the *Air* before it. If there chance to be a meeting of many *Vapours* together, then, according to the *Quantity of Matter*, the *Wind* is so much the greater, and diffuseth it self far and near.

VAPOURS derive their Original, not only from the surface of the *Water*, but likewise from the moist *Earth*, *Clouds*, *Snow*, &c. for the parts of these *Bodies* being not so firmly united, are easily disjoyned, and so break forth into the *Air*; where meeting with several *Exhalations* in their way, they together with the *Air* carry them along with them; because the *Air*, as well as *Exhalations*, contribute much to the Force and Violence of *Winds*. Tho' *Vapours* proceed promiscuously from the *Earth* and *Water*; yet the *Sun* shining raiseth more of them from the *Sea*, than from the *Earth*. And on the contrary, the *Earth* being heated with the *Sun-beams*, in the *Night* time, sends forth more *Vapours*, than the *Sea*; because the *Earth* longer preserves the heat of the *Sun*, than the *Sea*. Whence it is, that in the *day time* *Winds* are frequently perceived to blow from the *Sea*, and in the *Night time* more from the *Land*; as at *Jamaica*, and other of the *American Islands*.

Forasmuch therefore as the *Globe of Earth* and *Water* doth furnish a vast number of *Vapours* and *Exhalations*, which for the most dilate themselves between *Clouds*, *Mountains*, and other *Bodies* that are about them, by the force of this their dilatation, they rush from the places where they are streightned, into those where they find more Room and less Obstacles, and there vehemently tossing the *Air*, produce a *Wind*; much in the same manner, as we find that *Wind* is excited in *Aeolipyles*. Suppose we therefore an *Aeolipyle* A B C D E of *Brass*, all hollow, with a very narrow Orifice D, by which *water* is poured into it, the part A B C, to be full of *Water*; and other A E C, to contain nothing but *Air*. This *Aeolipyle* being set near the *Fire*, as soon as it is thorough hot, many of the *watry Particles* begin to whirl round, and being elevated above the surface A C, and variously dashing against one another, rush through the narrow hole D, (where they find the least Resistance) with great Violence, and putting the *Air* into a great Commotion, they produce a *wind* from D to F. Thus we may know and judge by this little Instance, of the great and wonderful Causes of *Winds*.

For the Hollow of *Mountains* may be compared, to the Cavity of this *Aeolipyle*: The *Heat* shut up in the *Bowels* of the *Earth*, to that whereby the *water* in the *Aeolipyle* becomes dilated and elevated: The *water*, which the *Sea* by *Subterraneous Channels* conveys into the *Earth*, to that which is contained in the said *Vessel*: And lastly, the *Clefts* of the *Earth*, at which the *Vapours* and *Exhalations* come forth, to the Orifice thereof.

to be understood by the word, Wind.

III. Whence Vapours and Exhalations do proceed.

IV. How Winds are raised, by the Example of an Aeolipyle.

Figure 50.

V. Mountains compared with Aeolipyles.

thereof. Only with this difference, that the smallness of the Hole in the *Aulipyle* causeth the *Vapours* to rush forth with greater violence, than they do from the more open and manifold Clefts of the *Earth*. Yet doth not this hinder, but that sometimes *Winds* may have as violent a Blast, as that which is perceived to rush through the small Hole of the *Aulipyle*; because some *Mountains* are so situated, that the *Vapours* that come from them, can but go one way, which makes them move with great violence and swiftness. Tho' sometimes also *Winds* may rise in those *Countries*, where there are no *Mountains* at all, viz. when the *Vapours* that move from a higher to a lower Place, are by the *Clouds* or *Mists* they meet with, forced to discontinue their course, and to turn off side-way.

VI.
Which are
the Cardinal
Winds.

According to the various parts of the *Horizon*, or *Quarters* whence the *Winds* blow, they are denominated *Cardinal* or *Collateral*. The *Cardinal WInds* are four, so called, because they blow from the four Corners of the *World*. The *East wind*, from the *Sun-rising*; the *South wind* from the *South*; the *West wind*, from the *Setting of the Sun*; the *North wind* from the *North*.

VII.
Which the
Collateral.

The *Collateral winds* are those, which are inserted between two of the *Cardinal*; and these, according to the Account of our Modern *Seamen*, amount to 28; viz. 7 between the *East* and *South wind*, 7 between the *South* and *West wind*, 7 between the *West* and *North wind*, and as many between *North* and *East wind*. So that the *Cardinal* and *Collateral winds* put together, make up the Number of 32.

VIII.
The Names
and Order
of the
Winds.

Figure
51.

To the end that the Order of the *Winds* may be the better understood, it will do well to mind the *Figure*, where they are all set down by their usual Names. The first is the *North wind*, the second is the *South wind*, the third is the *East wind*, and the fourth the *West wind*; which are called *Cardinal winds*. The 4 that follow are called *Collateral*; each of which is placed in the midst of 2 *Cardinal winds*, and hath its Name composed of the 2 *Cardinal winds*, between which it is placed, viz. the *North-east wind*, the *North-west wind*, the *South-east wind*, and *South-west wind*. The 8 remaining *Winds*, which are placed each of them betwixt a *Cardinal* and *Collateral wind*, take their Denomination from them both: Thus that which is between the *North* and *North-east wind*, is called *North-North-east*; and so of the rest.

IX.
Why the
East-wind
blows in
the Morn-
ing, and
the West-
wind at
Even.

The *East-wind* is chiefly found to blow in the Morning, because the *Sun* heating the *Air*, doth dilate, rarefie, and makes it to move in one and the same *Country*; sometimes one way, sometimes another, according as he is placed with respect to that *Country*. For this diversity of Position produceth variety of *Winds*. As for Example, When the *Sun* riseth to us, he dilates the *Air*, as hovering perpendicularly over it, and doth so whirl it round, that one part of it rusheth towards the *West*, where we are; whence it is that we then perceive an *East-wind*. On the contrary, when the *Sun* sets, the *Air* that is opposite to him becomes dilated, and thereupon one part of it must betake it self to the *East*, where we are then with respect to the *Sun*, and therefore must perceive a *West-wind*. And the same happening in all the *Countries* that are situate without the *Torrid Zone*, it

follows, that in the Morning *East-winds* must blow, and at Even-tide *West-winds*: As I have exprest it in a *Figure*, in my *History of Nature*, Part VI. Chap. II.

And with the like facility a Reason may be given, why *North-winds* most frequently blow in the *Day time*; by observing that the *Earth* E B F D, under the *Poles* E F, where it is not much heated by the *Sun*, is surrounded with *Clouds* and *Mists*; and that at B, where the *Sun* sends down his direct and perpendicular *Rays*, many *Vapours* are raised, which are carried upwards till they come thither, where, by the force of their own weight, they are more easily turned Side-ways, to continue their way towards I, and M, above the *Clouds* G, and K, than to mount higher in a *Right line*. And forasmuch as these *Clouds* G, and K, become rarefied by the heat of the *Sun*, the *Vapours* proceeding from thence, do rather take their progress from G, to H, and from K, to L, than to E, or to F: For the thick and gross *Air*, which is under the *Poles*, makes a stronger resistance, than the *Vapours* that rise from the *Earth*, towards the *South*; for these being strongly pushed, and on all sides ready for motion, do easily give way to them. So that if we suppose the *Northern Pole* to be towards F, the motion of the *Vapours* from K, to L, will excite a *North-wind* blowing in the *Day time* through *Europe*.

Altho' the *Sun* ceaseth its Action in those *Countries*, where it is *Night*; Yet because the heat imparted to the *Earth* in the *Day time*, is for some time preserv'd in it, it so happens that many *Vapours* are thereby raised, which the *Air* at P, being condensed by the *Cold* of the *Night*, hinders from roaming towards Q, and R; like as those which are in the other part, wander towards I, and M; but they are there (for we suppose it to be *Night* in the part D) gather'd into *Clouds*, which hindring other *Vapours* raised out of the *Earth* from ascending to any great Height, do on every side beat them down towards N, and O, and so produce a *South-wind*, which commonly riseth at *Night*.

As *Winds* proceed from different *Quarters* of the *World*, so they differ in their Properties: For those that blow from the *East*, are more violent than those that proceed from the *West*; and this partly, because these comply with the motion of the whole *Body* of the *Air*; and partly, because the *Air* that is dilated and blows towards the *West*, tends to a place, where for 18 Hours it hath not been *Noon*: So that by this long absence of the *Sun*, the *Air* is much more condensed, than that to which the *Western winds* tend; because there it is not above 6 Hours since it was *Noon*, and the presence of the *Sun*, caused a great heat and rarefaction of *Vapours*.

The *North-wind* for the most part is very strong and impetuous, because it is excited by the greatest heat, viz. that of *Noon-day*; and because it consists of a Matter that is most easily dissolved into *Vapours*, viz. *Clouds*. And for the contrary Reason, the *South-wind* must be the most gentle, as well because the *Thickness* of the *Nocturnal Air*, is a stop to its Course, as likewise because the Matter whereof it consist, as proceeding from the *Earth*, or from the *Water*, cannot be so readily, nor so copiously dilated, as is the *Northern matter*, which

X.
Why the
North-
wind, for
the most
part blows
in the day
time.

Figure
52.

XI.
Why the
South-wind
most
blows at
Night.

XII.
The East-
wind is
much
stronger
than the
West wind.

XIII.
The North-
wind is
more force-
able, than
the South-
wind.

XIV.
The East-
wind is
more dry
than the
West.

XV.
Which
Winds are
said to be
Dry, Moist,
Hot and
Cold.

XVI.
The Regu-
larity of
the Winds
is some-
times hin-
dered by
particular
Causes.

XVII.
What
Winds are
called Pe-
rennes, or
Continual.

XVIII.
What Venti
stati are,
that is,
such as
blow at
certain
Seasons.

which, as we have already said, is pour'd forth from the Clouds.

As to the other Qualities of the Winds, it is notorious that East-winds for the most part are dryer, and produce a more serene and clear Air, than those that come from the West; because these latter, by striving against the Natural Course of the Vapours, do stop them, and drive Clouds together, whereas the former do dispel and dissipate them.

Hence it is evident, that the North-wind is of a more drying Quality, that is, hath a power of driving watry Particles out of the pores of Bodies, or from their Outfides, whilst they are expos'd to the Air; because, for the most part, it is compos'd of the grosser parts of Fresh-water, mix'd with the Air. The same VVind is likewise cold, because it carries along with it the most subtil Northern matter, towards the South, which is the Primary Cause of Cold. But the South-wind is hot and moist: Moist, because it consists of the more gross, and subtil parts of Fresh-water, elevated together from the Earth: And it is Hot, because it brings along with it the Subtil matter, which was in the Southern quarter, towards the North. For the VVinds are much alter'd, according to the place through which they pass; and therefore, according to the Nature of the Region through which they go, are either Hot, Cold, Moist, or Dry.

All these things we have here spoken concerning the 4 Cardinal-winds, would happen so continually, if the Earth in all its parts lay equally above the VVater, and there were no difference of Soils and Springs, nor any other Cause, but the presence of the Sun, to dilate the Vapours; but there are so many other Causes that conduce to the production of VVinds, that it is no wonder to find them so irregular, and not to rise in the same Order. Wherefore we cannot with Reason expect Regular winds, save only in those parts of the Sea which are most remote from the Land. Forasmuch as there is no such great inequality in the surface of the Sea, as there is in that of the Earth; and because the VVinds, which are driven that way from the Shoars, very rarely can reach so far, as to disturb the Course of those VVinds that blow there.

Besides the foremention'd kinds of VVinds, some VVinds are called Perennes, that is, Continual; others statî, or such as blow at certain Times and Seasons; others, Provincial; and others, Free.

The Continual VVinds are 2; the one in the Torrid Zone, which continually blows from East to VVest: The other in the Temperate Zones, which, as far as about the 40th Degree, blows also from the East to VVest. These VVinds are very observable at Sea, but are scarce discernible at Land.

VVinds, Named by the Latins, statî, are such as return at certain and set Times. The most famous of this kind are the VVinds called Etesiae, which return every Year, towards the end of July, and continue 40 Days together, especially in Italy and Egypt: They blow at Night, about 3 hours after Sun-set, and for the most part cease at the approach of the Evening. Their Course is from the East or the North, or from between them both.

Provincial VVinds are such as blow in certain Provinces or Countries: Such is the North-wind, that blows on the North-side of the Alpes, according to the Course of a River, about 1 or 2 Leagues in length, but much less in breadth. This is a Daily-wind, and seems to blow continually, and with great evenness, like a River.

Those are called Free-winds, which without any order of time or place, do blow from different Quarters. Thus the VVest-winds blow most commonly about Noon, or after, when the Sun is hastning towards its setting. The South-wind frequently riseth at Night, and blows more vehemently than in the Day time; whereas the North-wind blows more in the Day time, than at Night.

As Vapours that are dilated in the Air, do produce Winds; so when they are compress'd and condens'd, they make Clouds. Which then happens, when their motion is diminished; for then their little Particles come closer together, which as soon as they are joyned, rise up in little heaps, and these gather'd together compose vast Bulks. For the Clouds are nothing else, but Vapours and Exhalations sublim'd so high, that the Coldness of the Air makes them come together, and so to constitute a Whole, which is so loose and spongy, that it cannot by its weight overcome the Resistance of the Air, which opposeth its descent.

Clouds do often interrupt the Action of Light; for tho' the Drops of Water, and the flocks of Ice whereof they consist are singly transparent; yet their multiplied Surfaces do repress the Light of the Sun. As appears in Froth, which because of the various surface of its Parts, cannot receive the Light. The Cause of this Condensation is, either the Winds which compress the Vapours together, especially if they be opposite, and blow from divers parts; or else the figuration of the Particles that compose the Vapours, whereby they are more fit to cling and close together.

The Reason why Clouds do not fall down out of the Air upon the Earth, is, because their Particles are very thin, and have large Surfaces, their Matter consider'd, and therefore are easily born up by the Air, which is ever thicker near the Earth; or else are hindered by the Winds from coming down: Much in the same manner, as a deep loaden Ship, is born up by the weight of the Water. Hence it is, that according to the less, greater, or equal weight of a Cloud, it doth either ascend, descend, or hang equally pois'd in the Air; even as a Ship, proportionable to its less, greater or equal Gravity, doth rise, sink, or is evenly pois'd in the Water. But when the particles of the Clouds are so thick, that they can no longer be kept up by the resistance of the Air, then are they resolv'd into Water, and by their weight fall down to the ground.

A MIST differs from a Cloud, only by the diversity of its place; for Mists are Vapours that reach to the very surface of the Earth; whereas those that constitute the Clouds are pois'd in the Air. For a Mist is nothing else, but a Dusky Vapour, hovering on the Earth, which continues either till it be drawn up by the Rays of the Sun, or by its own weight, or some other outward Cause, falls down to the Earth.

XIX.
Provincial
Winds.

XX.
Free Winds.

XXI.
The Original of
Clouds.

XXII.
How Clouds
come to
darken the
Light of
the Sun.

XXIII.
How Clouds
are support-
ed in the
Air.

XXIV.
The difference be-
tween a
Mist and
a Cloud.

XXV.
The Original of
Snow, Hail,
and Rain,
falling
from the
Clouds.

We are to take notice that the Parts of *Ice*, whereof I have said that *Clouds* consist, are not so joyn'd together; but that there is some distance between, so as to make up several little Heaps: So that if they chance to be shaken with any strong *Wind*, they are easily separated, and fall down to the *Earth*. If these *Hillocks* or *Flocks* are not wholly dissolved, they make *Snow*. But if the *Air*, through which they are carried, be so hot as to make them to melt, they come down in *Rain*. It happens also sometimes, that after they are turn'd into *Drops of Water*, a *Cold wind* meeting with them, congeals them into *Hail*; for *Hail* is nothing else but frozen or congealed *Rain*.

CHAP. XVII.

Of Rain, Dew, Hoar-Frost, and the Cool Evening Air.

I.
What Rain
is.

RAIN is nothing else, but those *Drops* into which a *Vapour* elevated above the *Earth*, is resolved. We have a resemblance hereof in distill'd *Liquors*; for the rising *Vapour*, being condensed by the Coolness of the *Air*, returns to its former state, and runs together into *Drops*, which at first are insensible, but in their falling do wⁿ are commonly increased, by others joyn^g with them; and those commonly are the largest, that fall down from the highest place.

II.
Whence the
difference
of Rain
doth pro-
ceed.

We must not therefore suppose, as some do, that *Rain* is produc'd in the *Air*, as *Water*, that by being poured from on high, becomes dispers'd into many *Drops*; or that it is generated in manner of a *Pool*, the *Water* whereof falling from the *Clouds* is dissolv'd first into greater, and then into less *Drops*; but only by degrees and by parts: For the *Drops of Rain*, are formed of the *particles of Vapours* joyn^g together, and being joyn'd fall down to the *Earth*. Hence *Rain* hath got several Names, according to the different bigness of the *Drops*, whereof it consists: For the *Rain* that falls down in small or midling *Drops*, is called by the common Name, *Rain*; if it drops very small, 'tis called a *Drizzling Rain*; if it falls down in great *Drops*, and those close and thick, 'tis called a *Shower*; if it comes down in great *Drops*, and fiercely, 'tis called a *Storm*.

III.
Whence the
Greatness
of the
Drops of
Rain
proceed.

The *Drops of Rain* are great, when the *Heat* acts upon the upper part of the *Cloud*; because then the *Drops* that descend do increase in their passage, by the addition of other *Drops* they meet with from the top of the *Cloud* to the bottom: Whereas on the contrary, when the action of *Heat* is only exerted on the lower part of the *Cloud*, as it commonly happens in the *Winter*, the *Drops* are so small, that they are not called *Rain*, but only a *Mizling Dew*.

IV.
How the
Rain
falls down
from the
Clouds.

Tho' it be evident enough how *Clouds*, that consist only of *Watry Drops*, come down in *Rain*, viz. either by their own weight, when the *Drops* by the coalition of many *particles*, have attained to a sufficient thickness; or, when that the *Air* that is under them, by its withdrawing, or that which is above, by pressing upon them, inclines them to a descent; or, when many of these Causes chance to concur: But yet it is not so evident to all,

how *Rain* is generated at first out of a condensed *Cloud*.

Now this will be easily made out, if we consider how 2 contrary *Winds* do gather great abundance of *Vapours* into the middle Space between them, and thereby cause the production of a *Mist* or *Cloud* there. For let us suppose, for Example, a *Wind* to blow upon the *Earth* A B, from the West D, and another to blow the contrary way, from the East C, so as that both these *Winds* come to stop one another about the Space F G P; it must necessarily follow, that the *Vapours* intercepted between the wind D, and the wind C, being driven together, must be there condensed, and make a kind of confus'd Mass. In like manner the *Wind* that drives against this *Cloud*, yet not with that Violence as to carry it along with it, must drive the parts of it closer together; by which means many of the *watry Particles*, which before were insensible, and separate from each other, are by the force of the *wind* driven together, and so become great *Drops*, which by their own weight fall down. For as in your common *Stills*, *Drops* are not formed as soon as the *Vapour* is got to the Head of them, for that other *Vapours* ascending to the top of the *Still*, must increase their bulk. So neither can *Rain* be generated, as soon as the *Vapours* are got up to the Region of the *Clouds*; but it is necessary, that those *Particles* of which the *Vapours* do consist, be by the *Wind* driven together, and more closely joyn'd; and that being thus become more heavy, so as to be able to vanquish the resistance of the *Air*, they fall down to the *Earth*.

Notwithstanding that by this way *Clouds* are often turned to *Rain*, yet is the *Heat* of the *Air* a more frequent and efficacious Cause of it. For this heated *Air* clinging to the *Clouds*, makes the subtil *Snow*, whereof they consist, to dissolve, and separates it into many little *Flocks*, which have then force enough to drive away the *Air* that opposeth their descent; and so by the action of the *Heat* they meet with in their passage, they are quite melted, and turn'd into *Drops*: Which sometimes are large, when the *Cloud* is thick and close, and comes down by the pressure only of the *Air* that is above it; because the upper *Drops* meet with others in their way downward, that increase them and make them larger, as before hath been mention'd.

The *Drops of Rain*, as they fall down, are made round: For a *Liquid Body* then becomes Round, when all its Parts are by an equal force driven towards some Common Center; for all the Parts of that Circumference being moved by a like force, are at an equal distance from the Center. Now *Rain* is a *Liquid Body*, all whose Parts, when the *Air* is calm and free from *Winds*, are compress'd by an equal Virtue to some Common Center. For the *Calm Air* doth on all sides equally compress these *Drops*, there being no Reason to be given why it should press them one way, more than another.

Having premis'd thus much concerning *Rain*, it will not be difficult to conceive how the *DEW* is formed, if we observe that when the *Air* is clear and not ruffled with *Winds*; many loose and thin little *Bodies* are dispers'd abroad, especially in the *Summer time*, when *Vapours* and *Exhalations* are copiously elevated from the *Earth*: Which

V.
Rain is
sometimes
caus'd by
Wind.

Figure
53.

VI.
The more
common
Cause of
Rain is
Heat.

VII.
Why the
Drops of
Rain are
Round.

VIII.
How the
Dew is
form'd.

Which small *Bodies* flying in the *Air*, in the form of *Vapours*, when the *cold* of the *Night* comes on, do lose their *agitation*, and many of them clinging together, produce insensible *Drops*, which falling down upon the *Dry ground* are suck'd up; but falling upon the *Leaves* of *Trees*, or the *Spires* of *Grass*, are there gather'd into greater *Drops*. This chiefly happens in the *Night*, or before *Day-break*; because then the *Earth* is most *cold*, as being turned from the *Sun*. Whence it follows, that the *Dew* is nothing else, but certain *Vapours*, that have by *Heat* been elevated in the *Day time*; and which being condensed by the *Coldness* of the *Night*, fall down in small insensible *Drops* upon the *Leaves* of *Plants*; where many of them joyning together, they become sensible.

IX. What Hoar-Frost is, and how it is distinguished from Dew.
HOAR-FROST is generated, when the *Vapours*, that are near the *Earth*, are congealed by the *coldness* of the *Night*: Which only happens in the *Winter*, when *Cold* predominates. For tho' when the *Coldness* of the *Night* is yet temperate, it be sufficient to compress the watry *Particles* up and down dispers'd through the *Air*, into sensible *Drops*, yet not to congeal them: But the *Cold* of *Winter-Nights* being more intense, congeals the said *Drops* in the form of *Snow* or *Hail*. So that it appears, that the difference between *Dew* and *Hoar-Frost* is this, That *Mists* do turn to *Dew*, if they consist of *Drops* of *water*; but into *Hoar-Frost*, when they consist of *Vapours* that are frozen before, or are congealed in their passage down to the *Earth*.

X. Why Hoar-Frost makes Coleworts tender.
It is observed, that the *Hoar-Frost* makes some *Herbs*, and particularly *Coleworts*, tender; the Reason whereof is, because the *Cold* acting upon them, doth very much condense them, and causeth many humid *Particles* to congeal together; which afterwards are easily resolved again by any supervening *Heat*, and by this means their fibres become in a manner clean dissolved, which is the cause of the *Tenderness* of those *Plants*. The like also happens in *Flesh*, which having been frozen, doth thereby grow very *Tender*.

XI. What the Cool Evening Breeze is, which is consequent upon clear Summer days.
As to that COOL EVENING-AIR, or *Breeze*, which is consequent to fair *Summer-days*, we find that it commonly happens when the *Heat* of the *Sun* hath been very intense all the *Day* long, and thereby greatly agitated the *Air*; by which means the surface of the *Earth* also is moved to send forth abundance of subtil *Exhalations* upwards, to the *Region* of *Vapours*; and because these *Exhalations* do more easily lose their agitation, than the *Vapours* do, as soon as they are deprived of the *Sun's Heat*, the former of these fall down. And herein doth chiefly consist the Nature of this *Cool Air*, or *Breeze*; which according to the difference of places, is endued with different *Qualities*: For it is probable, that those *Particles* which exhale from places *Infected*, or *poisonous Plants*, are far more hurtful, than simple *Vapours* that arise out of the *Earth*.

XII. When the Cool of the Evening is hurtful.
The *Cool Air*, or *Breeze* of the *Evening*, is never more hurtful, than when the *Day* fore-going hath been very clear, and the *Heat* of the *Sun* moderate: For the immoderate *Heat* of the *Day* doth much extenuate these *Vapours*, and elevates them on high, so that they cannot so readily be condensed by the *Cold* of the *Evening*. It is also very hurtful after that the *Sun* is set, because the

more heavy *Exhalations*, which have less of *Vapour* mix'd with them, as soon as they are left destitute of the *Sun-beams*, do immediately come downwards.

The *Air* cover'd with *Clouds*, is a sign of *Rain*, if the *Sun* shine in the *Morning*; for this is an evident Token, that there are no other *Clouds* in the Neighbourhood of our *Air*, towards the *East*, which can hinder the *beat* of the *Sun* from condensing those that hang over our *Heads*, or from raising new *Vapours*, whence they might be increased, out of the *Earth*. But this Cause only takes place in the *Morning*; for if it do not *Rain* before *Noon*, it cannot afford any signification of what is to happen in the *Evening*. Neither are those signs, which are taken from the *Croaking* of *Frogs*, or *Crows*, the *Presentions* of *Beasts*, the *Redness* of the *Sun*, the *Paleness* of the *Moon*, and other such like, any whit more certain, but generally very fallacious: And he that would take the pains to observe them diligently, will frequently find the contrary, to what is commonly expected from such like *Presages*.

Yet we find, that when no *Dew* falls in the *Night*, or the *Mist* is carried upwards, leaving the *Earth* destitute of all *Moisture*, this is a sign of *Rain*; because this seldom happens, but when the *Earth*, having not been sufficiently cooled in the *Night-season*; or been agitated by too much *heat* in the *Day time*, doth send forth abundance of *Vapours*, which driving the *Mist* upwards, make its *Parts* to run together; by which means they become so great and weighty, as that they are forced to come down in *Rain*.

XIII. If when the Air is dusky, the Sun shines in the East, it is a sign of Rain.

XIV. When no Dew falls in the Morning, it is a sign of Rain.

CHAP. XVIII.

Of Snow and Hail.

SNOW may be said to be a dissolved Cloud, which being driven downwards by its own weight, falls down to the ground in Flocks. It is said to be a Dissolved Cloud; because a Cloud is nothing else, but a great heap of *Snow* close clinging together. And it is said to be Dissolved, because when the union of the parts of a Cloud are broken by force, one part of it becomes sever'd from its next part, and being more weighty than the *Air*, comes down in the form of *Snow* or *Rain*. It is said in the next place, that it is driven downwards by its own weight. For a Dissolved Cloud, by its own weight, either turns to *Snow*, *Rain*, or *Hail*. And lastly, it is said, that it comes down in sever'd or distinct Flocks. For as a Flock of *Wool*, consists of many particles of *Wool*, entangled together; so the Flocks of *Snow* are compos'd of many Shaggy particles clinging together.

It is not always necessary, that the parts of Clouds should be wholly melted before they come down, since it is common for them not to be dissolved, or to turn to *Drops*, before that they come near the *Earth*, where the *Heat* is strongest, as exceeding that which is on high. Wherefore, when the parts of a Cloud that are only condensed, without being melted, do meet with the cold *Air*, which is no longer able to bear them, they fall down with their own weight, and that in Flocks of *Snow*, and not in *Drops*.

I. What Snow is.

II. How Snow and Hail are formed, and why they are white.

To

III.
How the
Snow,
whereof
Clouds con-
sist, is
condensed.

To understand the way how the *Clouds* come to be condensed, we are to suppose that the *Heat* which commonly rarefies most *Bodies*, doth notwithstanding condense that of *Snow*; whose *Parts* are so separate from each other, that the least agitation is sufficient to bring them together. Whence it comes to pass, that when the *Air*, which is near the *Earth*, and is always more hot, than that which is at a greater distance from it, comes to elevate it self to the *Clouds*, either by the Force of some *Wind* that carries it along, or by the Action of some new *Fermentation*, which causeth it to swell, it is necessary that it condense the *Snow*, whence the *Clouds* are composed.

IV.
How Hail
is produc'd,
and what
is the fi-
gure of it.

The *Flocks* of *Snow* are of a *white Colour*, because the *watry Matter*, whereof they are composed, contain a great deal of *Air*; and its *pores* are so disposed as to reflect the *Light*, rather than to afford it a free passage, as *Ice* doth. But if these small *Flocks*, after that they are melted by warm *Air*, do afterwards meet with other *Air* that is cold, and by it are congealed; then they turn to *Hail*, whose *Stones* are of a different Figure, according to the various Solution of the *Flocks*. For if the *Cold wind*, that congeals the *Hail*, doth meet with the *Flocks* of *Snow*, when they are almost dissolved, but not yet rounded into *Drops*, then they obtain an *Horned figure*; and when the *wind* meets with the *Drops* of *water* already formed, it produceth little transparent round *Pellets*, save only that commonly they are somewhat flattish on that side where the *wind* beats upon them.

V.
Why the
Hail is
sometimes
of a Coni-
cal figure.

So that from the divers degrees of *Heat* where-with the *Air* is agitated, and whereby the *Cloud* must be dissolved, there ariseth a great variety of *Effects*. For if the *Heat*, which by the *Cold wind* is driven into the *pores* of the *Flocks*, and penetrates their inmost *Parts*, chance to drive them towards the *Center* and condense them, whilst the *External parts* being become stiff and bound by the *Cold*, cannot follow, they must of necessity be slit, according to *Right lines* tending to the *Center*; and as the number of these *Slits* do increase, as the *Cold* penetrates deeper, they must at last fly in pieces, into many longish and *Pyramidal particles*, which are so many *Hail-stones*, which at the first approaching of *Winter*, fall down to the ground, especially if a *Spring-like* constitution of the *weather* have gone before.

VI.
Why it
seldom
Hails in
Winter.

For it is apparent, that it cannot *Hail* much in the *Winter*; or if it doth, the *Stones* cannot be great. The Reason is, because during that *Season* there is seldom *heat* enough so high as the *Clouds* to melt them; but only when they are so low, as that being melted, or near melted, they have no time to be congeal'd again before they reach the *Earth*. Whence *Hail* may be described to be a *Cloud* that is melted, either whole or in part, and being driven downwards by its own weight, becomes so congealed by a *Colder wind*, that it falls down commonly in round and transparent *Pellets*.

VII.
Whence the
different
Figures of
Hail do
proceed.

The *Hail-stones* are sometimes of an *Oval figure*, viz. when a melted or dissolved *Cloud* is stronger compress'd on one side, by the *wind*, than on the other. Sometimes they are rough, by reason of many *Angles*, which happens when a *Cold wind* seizeth the *Flocks* of *Snow* as they are melting, but before they are turn'd into round *Drops*

of *Rain*. To which may be added, that the *Hail-stones* are sometimes so violently dash'd against the *Earth*, as thereby to be broken to pieces, and so lose their *Natural figure*.

But much more wonderful is the figure of *Snow*, which sometimes is *Hairy*, as in M and Z, sometimes *Six-corner'd*, and consisting of 6 equal *Rays*, like *Stars*, as in O; sometimes like a *Rose*, as at Q; sometimes in the figure of 6 *Rays*, or like 3 *Rods* laid *Crosswise*; which like greater *Branches*, shoot out lesser *Branches* from them, the broadest whereof are nearest to the *Center*, so as to reach and entangle one another; and the shortest or narrowest towards the *Top*, making a *Corner'd* or *Angulous Ray* or *Beam*, as in R.

HAIRY-SNOW MZ, is produc'd, when the particles of *Ice*, which constitute the *Flocks* of *Snow*, being condensed by the heat of the *Air*, and several times after congeal'd by the *Cold*, whirl round their own own *Centers* in the *Air*: In which motion they are cover'd with some longish and slender particles of *Ice*, as with *Hair*, and so exhibit the figure of *Hairy-Snow*.

Snow of a 6 *Corner'd* or *Starry figure*, O, is formed, when the *Wind*, which hath dispos'd the *Flocks* of *Snow* into the form of *Leaves*, by passing freely betwixt them, doth melt the particles of *Waters*, that stand upright like *Haws*; so that afterwards insinuating it self into the 6 *Corner'd Spaces*, it melts the most subtil and loose *Snow* that is about the *Circumference* of them; and the particles of *Water*, being agitated by the force of heat, joyning themselves with others that are not melted, do presently congeal them; and so their *Hair-like Extremities* being bent this way and that way, the *Flocks* grow less, and are changed, as it were, into a small plate of *Ice*. And as to those *Hairy prominences*, which are melted in the *Circumference* of these *Intervals*, these become condensed, whilst they withdraw themselves towards those which joyn every one of these *Flocks*, to 6 others that surround it: By which means 6 *Breaches*, or *Slits*, are made in the 6 parts of the *Circumference*, where the *Heat* is most predominant.

Snow is formed into the figure of a *Rose*, Q, when the *Heat* of the *Air* is somewhat greater, than what we just now supposed: For then dashing against these 6 prominent *Points*, it makes them shorter; and causeth the plate of *Ice*, which before resembled the figure of a *Star*, to become like a *Rose* with 6 *Leaves*, the points being rounded like the *Teeth* of the *Wheels* we see in *Watches*.

If the *Flocks*, whereof *Snow* is composed, be bigger than ordinary, it may happen that by this means it may be not only divided into 6 places, in order to the forming of 6 points; but that also every one of those 6 points, be divided into 6 others, by the intervening of 2 *Breaches* or *Slits*, from the *Hairy prominences* or *Capillaments*, which reach the *Capillaments* of another *Flock* of *Snow*: So that by this means 2 points might be formed, bending outwards; because the *Heat* there acting with more vehemence, produceth a greater *Condensation*: And thus instead of one *Starry-point*, or a *Rose-leaf*, there must appear the *Leaf* of a *Lilly*, as is represented in R.

Some

VIII.
The various
Figures of
Snow.

Figure
54

IX.
How Snow
comes to be
of a Hairy
figure.

X.
How Snow
comes to be
formed
into the
figure of
Stars.

XI.
How the
Flocks of
Snow are
formed
into the
Figure of
Roses.

XII.
How the
Flocks of
Snow come
to resemble
Lillies.

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To the Right
Wentworth Earle
Wentworth, and
Woodhouse, New=
and Raby, Knight



Honourable William
of Strafford, Viscount
Baron Wentworth=
march, Oversley,
of the Garter &c.

This Plate is humbly

Dedicated by Richard Blome

XIII.
How some
of these
Snowy
Stars come
to be white,
or pellucid.

Some of these *Snowy Stars* are white, like refined *Sugar*; and others of them are Transparent. The *Whiteness* of them proceeds from the *Mediocrity* or *Temperateness* of *Heat*; as when it hath not force enough to pierce to the bottom of the *Matter* whereof they are composed. Or because in their passage through the *Air*, they have joyn'd to themselves some particles of *Water*, before they got down to the *Earth*. Whereas other *Flocks*, that are more thin and small, are transparent; because the *Heat* hath wholly penetrated them, and made their particles to come nearer, and to be joyn'd more closely together.

XIV.
How there
comes to be
a Point in
the midst
of the
Rosie-
Snow.

One thing remains still to be noted, viz. that there is seen a *white Point* in the Center of the *Rosie-Snow*, as is represented in Q. The Reason whereof may be, because the *Heat* that hath formed these *Stars*, is so moderate, that tho' it makes all their other parts pellucid; yet not being strong enough to pierce to their Center, it leaves them white.

C H A P. XIX.

Of Thunder, Lightning, and Coruscation, or Flashes.

I
Lightning
and Coru-
sation fol-
low after
Thunder.

TO the end that the Nature of *Lightning* and *Coruscation* may be the better understood, we must premise something concerning *THUNDER*; for usually they are Concomitants of it, and depend on it, as their Cause. Now *Thunder* is produc'd, when many *Clouds* rush down upon others that lye directly under them. For it comes to pass sometimes, that the highest *Clouds* being condensed by *Heat*, and made more weighty, fall down upon others that lye under them, and cause that Noise which we call a *Thunder-Clap*. For it cannot be question'd, but that in the *Summer time* especially there are abundance of *Nitrous*, *Fat* and *Sulphureous Exhalations*, in the *Air*. It is certain also, that *Snowy Clouds* are condensed by *Heat*, and thereby become more Heavy. It is also as apparent, that all *Clouds* are not of the same height, but some higher, and others lower; since besides Reason, Sense it self comes to confirm it, which often shews us one *Cloud* moving over another. These things being thus presuppos'd, we proceed to the Explication of *Thunder*, *Lightning*, and *Coruscation*.

II.
What
is the
Cause of
Thunder.

When any *Clouds* condensed by *Heat*, and by this means being become more Heavy, rush down upon an *Inferiour Cloud*, the intermediate *Air* being thereby strongly agitated, is the cause of a dreadful Sound, which is called *Thunder*. For let us suppose two *Clouds* A and B, composed of loose and much dilated *Snow*; let us also suppose, that there is a warmer *Air* about the upper *Cloud* A, than about the lower *Cloud* B; it is evident, that for this Reason it must be more and more condensed, and consequently become more Heavy: So that its most outward parts falling down first, push others they meet with in their way, and hurrying them along with them, do at last rush down all together, with great Violence, upon the *Lower Cloud*, with a dreadful rumbling Noise.

III.
Heat con-

I have said, that *Heat* condenseth the *Clouds*: For tho' *Heat* do rarefie some *Bodies*, yet

it ordinarily is wont to condense *Clouds*, as hath before been said of *Snow*, which consists of the same matter as a *Cloud* doth. For if *Snow* be laid in a warm place, it contracts it self into a less Figure, before that any *water* drop from it, or its weight be diminished. The *Clouds* therefore being thus condensed, do easily descend, and oppose the passage of others that moved upwards, by reason of their Looseness, and thrust downwards whatsoever opposeth them in their way. And forasmuch as this cannot be without a violent concussion of the *Air*, therefore it is accompanied with that terrible Noise, the resounding *Air* making it still louder.

Thunder therefore is a Noise excited by the *Air*, which hath been intercepted between two *Clouds*, whereof the Upper falling upon the Lower, and which being forc'd to retire thence, by the weight of the middle part of the Upper *Cloud*, which continues to come down, forceth for it self narrow and irregular Gaps, to get out by, which produceth a dreadful Sound, being much augmented by the Rarefaction caused by the enkindling of the *Nitrous Sulphurs* betwixt these 2 *Clouds*.

It *Thunders* but rarely with us in the *Winter* time, because then the *Heat* that is sufficient to dissolve the Upper *Clouds*, cannot reach so far. But in the *Summer time*, when the *Heat* is violent, and more especially when the *North-wind* makes the *Heat* to be more close and stifling, *Thunder* is produc'd; because this wind is wont to carry the heated *Air*, that is near the *Earth*, upwards, to those higher *Clouds*; by which means not only those *Superiour Clouds* are condensed and rush'd downwards, but also the Lower continue so loose and dilated, and by the Dilatation of the *Air* that is under them, are so thrust upwards, that they, as it were, meet the others falling down upon them, and stop them there, hindring any part of them from coming down to the *Earth*.

Thunder is commonly follow'd by a *Shower of Rain*, and when the *Rain* is very copious, it is a sign that little more *Thunder* will follow; because when the Force wherewith the Upper *Cloud* rusheth down from the Lower, is strong enough to make it come down wholly, the *Thunder* must needs cease: And if it be not strong enough, and the Lower *Cloud* dissolves into *Rain*, the same thing will still happen; because the *Air* that is shut up betwixt the 2 *Clouds*, can now with ease get forth, because of the small resistance of the Lower *Cloud* dissolving into *Rain*.

The Sound of *Bells*, and of *Canons* discharged, makes *Thunder* to cease; because thereby the *Air* is strongly agitated, and communicating its motion to the Neighbouring *Air*, and that again to the Intermediate, till it reach and shake the *Snow*, whereof the inferiour *Cloud* consists, occasions its descent. Which Experience makes evident to those, who are us'd to Travel in those *Vallies*, where the falling down of heaps of *Snow* from the *Hills* is apprehended; for fearing lest the Sound of their Voice, by shaking the *Air*, should bring down the *Snow*, they are afraid so much as to Cough, to prevent that danger.

denseth
the Clouds.

IV.
What
Thunder
is.

V.
Why Thun-
der is
much more
frequent in
Summer,
than in
Winter.

VI.
Why every
Clap of
Thunder is
commonly
follow'd by
a Shower
of Rain.

VII.
The Noise
of Bells
communicateth
to make
Thunder
cease.

VIII.
What is
the Cause
of Coru-
sation.

The *Exhalations* that are found in that Space which is between the 2 *Clouds*, are the *matter* of *Coruscations* and *Lightning*, and according to the degree of *Rarefaction* and *Condensation*, produce either the one or the other: For *Coruscation* proceeds from an abundance of very subtil *Exhalations*, and very inflammable. For these subtil and sulphureous *Exhalations* in the *Air*, become kindled by this *Agitation*, by reason that the *Matter* of the first *Element* being by this *Concussion* deliver'd from its *Bonds*, doth most swiftly run through them, which is the Reason of those *Flashes*. This does frequently happen after great *Heat* and *Droughts*; for then by the dashing together of *Light Clouds*, a *Flame* is kindled and breaks forth, which often reacheth our *Eyes*, without the *hearing* of any *Noise*; because the *Clouds* dashing against each other, is too soft to be heard at so great a distance.

IX.
What is
the Cause
of Light-
ning.

But if the *Exhalations*, which are intercepted between 2 *Clouds* rushing against one another be thicker and closer, then with great vehemence breaking through the shatter'd *Clouds*, and obliquely darted down to the *Earth*, they constitute the *Lightning*; by which (according to the condition of its own *Matter*, which sometimes is more thick, or gross and copious, and therefore more Violent; and at other times, more subtil and in less quantity, and so more penetrative; or of the *matter* of its *Objects*, whereof the more hard and solid, do make a greater and stronger Resistance, because they cannot give way, and so are dissipated by it: Whereas the softer and porous *Objects* do easily give way, but withal more readily take *Fire*) those wonderful and stupendous Effects are produc'd, which strike Mens *Minds* with Astonishment, and force the most impious *Minds*, tho' fore against their wills, to revere the *Divine Power*.

X.
Of the
Thunder-
bolt.

It is commonly believ'd, that besides the *Coruscation* and *Lightning* which proceed from the 2 *Clouds*, there comes forth also a hard *Stony substance*, which is called a *Thunderbolt*, tho' it is own'd that the same is not always discharg'd, as oft as it *Thunders*; but some think this is only asserted, and not proved. Yet if any such thing should be, we must suppose it to be generated of some gross *Matter*, which in its descent, hath by the great *Heat* been reduc'd to that hardness.

XI.
How the
Lightning
differs
from Co-
ruscation.

The difference between *Lightning* and *Coruscations* or *Flashes*, is this: *Coruscations* or *Flashes*, may be caused by *Exhalations* that lye under one *Cloud* only; whereas *Lightning* doth not proceed, but from such *Exhalations* as are intercepted betwixt two or more *Clouds*. Because *Lightning* is an *Exhalation* with a great force breaking through the *Clouds*, which cannot be, but by *Clouds* that lye one upon another, when by the heavy fall or rushing down of the upper *Cloud*, the *Exhalations* are kindled, and through a Breach made in the *Lower Cloud*, are darted downwards towards the *Earth*. We must conceive that the whole *Upper Cloud* rusheth down upon the *Lower* equally and altogether; for then it *Lightens*, by reason of the kindled *Exhalations* breaking through the *Lower Cloud*.

XII.
The Defini-
tion of

For *Flashing* or *Coruscation* is nothing else, but an *Exhalation* spread under a *Cloud*, which by the

motion of the said *Cloud* rushing downwards, is set on fire, and flasheth. Much after the same manner, as a *Torch* newly put out, and yet *smoking*, is by some violent and sudden *motion* again enkindled. But *Lightning* is an *Exhalation* intercepted between two or more *Clouds*, which by the Heavy Fall of the Superiour *Cloud* is not only kindled, but through the *Lower Cloud* is thrust down to the *Earth*.

The *Lightning* doth more frequently strike the *Tops* of the *Mountains* and *Steeple*s; for seeing that the *Clouds*, where the *Thunder* is generated, are high, and that the breach is usually made at the end of them; it cannot well be conceived, but that the *Exhalation* that breaks forth thence, rushing down slantingly, must needs meet with the highest *Bodies* first. To which we may add, That if 2 *Clouds*, whose *Ends* are separate from each other, were to open in the *Lower* part of them, we must suppose that it would rather happen in that part which answers to the High *Body*; because the same, by hindring the descent of the *Air*, doth determine it by its Resistance, to break rather in that place, than in any other.

The various Effects of *Lightning* are to be attributed to the composition of the several *Exhalations*. It burns the *Cloaths* or *Hair* of a *Man*, without touching his *Body*; because the *Exhalations* whereof it consists, is of the nature of *Oil*, whose flame is weak. Sometimes it melts the *Gold* that is in a *Mans Purse*, and the *Sword* in the *Sheath*, without hurting the *Purse* or *Sheath*; which happens, because the *Exhalations* are very subtil, as participating of the Nature of *Salt* and *Aqua-Fortis*, by which means they pass through porous *Bodies* without any Impediment or hurt to them; but dissolve whatsoever resists entrance. As we find much the same effect of *Aqua-Fortis*, which dissolves the *Hardest Bodies*, and yet leaves *Wax*, and other *Soft Bodies*, in a manner unrough'd.

CHAP. XX.

Of the *Rainbow*, *Circles* about the *Sun* and *Moon*, and of *Mock-Suns* and *Mock-Moons*.

THE *RAINBOW* may be defin'd a *Bow* of diverse Colours, which the opposite *Sun* paints on Drops of *Water* by a various Modification of his *Light*. It is called a *Bow*, because it is represented in the figure of half a *Circle*. For the *Rainbow* is a portion of that *Circle*, which is drawn from that *Line*, as from its *Center*, which passeth from the *Sun*, through our *Eye*, called the *Axis Visorius*. It is said to be of many Colours; because of the several Colours which may be discern'd in it. And lastly, it is said, That the opposite *Sun* paints, or represents it, in *Watry Drops*, these being indeed the *Matter* of a *Rainbow*.

We shall the better be able to understand the nature of a *Rainbow*, by taking a view of all the particulars that are contained in it. First then, we say that the *Rainbow* is represented in a *Dewy Cloud*. Secondly, That the *Dewy Cloud* consists of innumerable drops opposite to the *Sun*. Thirdly, That

Flashing
ing and
Lightning.

XIII.
Why the
Lightning
commonly
strikes
Mountains
and the
Tops of
Steeple.

XIV.
The vari-
ous Effects
of Light-
ning.

I.
The Defi-
nition of a
Rainbow.

II.
What
things are
to be notice
in a Rain-
bow.

That every one of these drops are like a *Globe* of *Glass* filled with *Water*. Fourthly, That all and every one of these drops, being heavy, and consisting of particles of water joined together, are carried downwards. Fifthly, That the *Rainbow* is produced in such a manner in that part of the *Air*, which is opposite to the *Sun*; that the *Spectators* are in the middle between them, so that if a line drawn from the *Sun* to the *Eye* of the *Spectator*, should be continued, it would pass through the *Center* of the *Rainbow*, and consequently that the *Center* of the *Rainbow*, the *Eye* and the *Sun*, are placed in the same line. Sixthly, That the drops of water, illustrated by the *Sun*, must be round, and send back the *Sun-beams* from each part of their surface, either by *Reflexion* or *Refraction*.

III. To the end we may the better conceive, how the various colours of the *Rainbow* are represented to us, we are to presuppose that we can never perceive them, but when the *Sun* shines, whose *Rays* are either reflected to our *Eyes* from the surface of some *Opake Body*, or are transmitted to us by passing through a *Body* that is partly transparent, yet ting'd with some colour or other: Or, Lastly, They reach our *Eye* by passing through some *Diaphanous Body*, wherein they have met with some *Refraction*. For no other way can be imagined for *Beams* to come to us, besides one of these three. Now because these *Beams* which proceed to our *Eye*, from a *Dewy Cloud*, cannot be said to be reflected from an *Opake Body*, seeing it is not at all probable that any such can be so suddenly form'd in the *Air*: or any *Body* that is in some sort *Transparent*, but yet coloured, to send back the *Rays* of *Light* to us in such a manner as is necessary for us to see the appearance of a *Rainbow*: and that we find by experience, that when a *Rainbow* appears, the *Air* is full of watry or dewy Drops, which are transparent, without any colour; therefore we may with good ground conclude, that the *Rainbow* represents these colours to us, only by the mode or manner of the *Sun-beams* acting upon the Drops they pass through, and so suffering some *Refraction*.

IV. This may be confirm'd by many Examples, as by water spouted out by *FULLERS* when they bedew and moisten their *Cloath*. In those *Bubbles* which *Children* make by dipping a *Straw* or other small *Pipe* in a *Lather* of *Soap* and *Water*. And in *Artificial Fountains* that cast up *Water* to a great height, which being there dispers'd in the *Air* do exhibit the form of a *Rainbow* on these scatter'd drops, illustrated by the *Sun*.

V. The chiefest colours are *Scarlet* or *Crimson Red*, which is seen in the utmost part of it; next to which is *Yellow*, the third *Green*, and the inmost *Purple* or *Violet colour*, or as others will have it *Blew*. I said that these are the chiefest colours, because by the mixture, passage and termination of these, many other colours arise. The foresaid colours are chiefly seen in the *Primary Rainbow*, which many times appears alone. But in the *Secondary Rainbow*, which is higher and more large than it, these colours are weaker, and turn'd the contrary way: for in it the *Purple* is the utmost colour, the next *Green*, the third *Yellow*, and the lowest deep *Scarlet*. And the same thing happens in a *Prism*, according as the same is beheld upwards or

downwards, for accordingly the order of those colours appears inverted to us.

As to the cause of these various colours that appear in the *Rainbow*, it will be sufficient for us to know that *Light* is nothing else but a certain action or motion of a subtil matter, whose particles, like so many *Globuli* or round *Pellets*, are conceived to roul through the *Pores* of *Earthly Bodies*; which *Globuli*, according to the variety of the *Causes*, which determin their *Actions* or *Motions*, are diversly moved. So that if we suppose them to be so determined, that they whirl round with a greater force, than they move according to a *Right Line*, they produce a *Deep Red Colour*: if they be not whirl'd about altogether so strongly they imprint the sensation of a *Yellow*. And on the contrary, if they be not whirl'd about so fast, as used to be at other times, when there is no such Cause to resist their motion, they produce a *Green colour*; and a *Blew* when they are mov'd much more slowly.

How these Colours are produced, we shall easily apprehend, by exposing a *Globe of Glass* B C D, to the *Sun*; for then we shall see, supposing the *Sun* to shine in the part of *Heaven* A F Z, and the *Eye* placed in the point E, that the part D, of the *Bottle* or *Globe* of *Glass*, will be ting'd with a deep red colour. And that whether we bring it nearer, or remove it farther from us, the same colour will still appear to us, provided we keep the same station; and that the line D E, with the other E M, which we are to conceive drawn from the *Center* of the *Eye*, to the *Center* of the *Sun*, do constitute an *Angle* of about 42 degrees, for then the part D will be equally coloured *Red*. But if we should dilate this *Angle* a little, this *Redness* will disappear; and if we contract the said *Angle*, then will it not altogether vanish, but will first be divided into two parts less bright, in the which *Blew*, *Yellow* and other colours will appear.

Afterwards if we proceed and view the part of the *Glass Bottle* K, we shall observe, by making the *Angle* K E M, of about 52 degrees; that the said part K, will be likewise ting'd *Red*, but not so bright and lustrous as that of D; and that upon dilating the said *Angle*, as before, other colours will appear, but more weak and fading, and that upon our contracting the same, or by dilating the same much wider, they will wholly vanish.

From which instance we are plainly inform'd, that the whole space of the *Air* to M, being filled with such *Glass Globes*, or which is equivalent in this case, with drops of *Water*, some point of them must be ting'd with a *Red colour*; from whence the lines drawn to the *Eye* E, will with the line E M, constitute a line of about 42 degrees, such as we suppose those to be that are marked by the *Letter* R; and that these points considered altogether, without observing the place wherein they are, save by the *Angle* under which they are beheld, will appear like a continuous *Circle* of a *Red colour*; and so likewise that there must be some points in those Drops, which are at S and T, from whence lines drawn to E, will constitute somewhat more acute *Angles* with E M, by which the *Circles* of the more weak and fading colours are composed. And that in this the *Primary* or *Inward Rainbow* doth consist. Then supposing the *Angle* M E X, to be of 52 degrees, that a *Red Circle* must appear in

VI. What is the Cause of the Colours in the Rainbow.

VII. How these various Colours do appear in the Rainbow.

Figure 56.

in the Drops at X, and other Circles of a less deep colour, in the Drops at Y; and that in this the Secondary or outward Rainbow doth consist. And lastly, that by all the other drops marked V, no colours at all are produced.

VIII. A Primary Rainbow therefore is produced by those Rays which come to the Eye after 2 Refractions, and one Reflexion; whereas the Secondary is generated of the Solar-beams, reaching the Eye, after 2 Refractions and 2 Reflexions. For if we make a more accurate search whence the Red colour proceeds, which appears in the part D, of the Round Glass, we shall find that it depends on the Sun beams (which we look upon as so many parallel lines, because of the vast distance of the Sun from us) which coming from A, to B, entering the water, are refracted in the point B, and go on to C, whence being reflected to D, and there coming out of the water, and a second time refracted tend to E. For as soon as any Opaque Body shall be opposed to any of the Lines A B, B C, C D, or D E, immediately the Red colour will disappear; and tho' we should darken the whole Ball of Glass, excepting only the 2 points B and D, and should round about beset it with Opaque Bodies, provided nothing do hinder the Action of the Rays A B C D, yet the same will shine brightly. Afterwards having in the same manner searched out the Cause of the Red colour appearing in K, we shall find that the same depends on the Solar Beams, which coming from F to G, are there refracted towards H, and in H, reflected to I, and again from I, reflected to K; and lastly being again refracted in the point K, tend towards E. And therefore a Primary Rainbow is represented in a Dewy Cloud, or in the several drops opposit to the Sun, after 2 Refractions and 1 Reflexion: but the Secondary after 2 Refractions, and as many Reflexions.

IX. If any object that Rainbows sometimes appear in those places where there falls no Rain at all; and therefore they do not always proceed from those Causes we have here assigned to them. I answer that a Rainbow is ever represented in Rainy Drops, and that they never appear but in rainy weather; for the Rainbow is an individual companion of Falling Rain, tho' possibly it may not rain in that place from whence the Rainbow is seen, yet sure it is that it must rain in that place where it appears.

X. Tho' a Rainbow be visible to all, yet it is not seen by all after the same manner: For seeing that the Drops which appear stain'd with some colour, are perceived about the Axis Visorius, under a certain Angle, and that all Spectators have a different Axis, it follows that every one of them must have his peculiar Rainbow. Yea, if the same person chance to go back, or forward, only some few steps, he will not behold the same, but still a different Rainbow; seeing that the Drops of Water, are for example, represented under a certain Angle of Refraction, as the said Angle is enlarged by going forwards, or diminished by going backwards, the Rays of Light will be variously returned, and will make a different Rainbow. So that there are as many Rainbows, as there are places, from whence they are beheld; wherefore it is no wonder what the Proverb saith, that the Rainbow flies from those that follow it, and follow those that flee from it.

HALOS, or the Circles which appear about the Sun and Moon, are much of the same nature with the Rainbow. For they are round like the Rainbow, or approach to it, and have always some Star for their Center; for how swift soever the Stars motion may be, it is always found in the Center; which is a manifest Argument, that these conspicuous Circles or Crowns are produced by Reflexion or Refraction. They agree also with the Rainbow in this, that they are of various colours like it; whence we must conclude that Refraction, and a shadow that may terminate the Light, are necessary to the Production of these Circles.

Yet these Circles differ also from a Rainbow, because a Rainbow is never seen but in rainy weather, tho' it be not necessary that it should always rain where the Spectator is. Whereas these never appear in rainy weather, which is a plain argument that they are not generated by Refraction made in the drops of water, but by that which is made in the particles of Ice, found in the figure of Stars; for we cannot meet with any other Cause to which we may ascribe this effect.

When therefore at any time there be Clouds in the Air, of a moderate thickness, the Light of the Sun or Moon, piercing the little particles of Ice, whereof they are composed, becomes refracted in such a manner, that not being visible save only to a certain distance from those Stars, it produces the appearance of several colours, viz. Red on the shady side, and Blew or Purple on the side toward the Sun or Moon.

As for example, when the Beams, proceeding from the Sun or Moon A B C, darting against a Heap of Icy Stars G E F, lying upon one another, are refracted, and reach the Eye of the Spectator D. For if the Beam proceeding from the point A, to the end of the Icy Star G, and the Ray from the point C, to the end of the little Star F, be refracted towards D, it is plain, that besides the Beams A D, and C D, and such like, which passing in a right line, do represent the Sun or Moon in their proper form; others being refracted in E E, will make the Air comprehended in this Circle F F, very Bright, and represent its circumference betwixt the Circles F F, and G G, in the form of a Crown or Circle distinguish'd with the colours of the Rainbow. So as that the Red colour will appear on the inside about F, and a Blew colour on the outside at G.

There are likewise other CIRCLES formed in the Clouds, but very different from those we have now mentioned: because they appear only of a White colour, nor have they any Star in their Center, as the Circles or Halos have; but for the most part pass through the Centers of the Sun or Moon, and seem to be altogether, or almost parallel to the Horizon. And these are only seen in Great and Round Clouds, covered with Ice, in which Mock-Suns are represented by means of Reflexion or Refraction. For the Sun darting its Beams against a Snowy Cloud that is covered with Ice, and from the Ice reflecting into the Snow, must represent the same to the Eyes of the Spectators standing on the Earth under it, in the form of a great Circle. Hence it is that these PARHELIA are called Mock-Suns, because they are reflected re-

XI. What Halos are, and wherein they agree with the Rainbow.

XII. How these Circles differ from a Rainbow.

XIII. How these Circles are formed in the Clouds.

XIV. A further Explanation on how these Circles are formed about the Stars.

Figure 57.

XV. How these Circles are produced in which Mock-Suns are formed.

Book. 1. Part. 6. Chap. 21.



*To the Worshipfull
of Southampton in
Second Engineer*



*Thomas Phillips
Flant Shire Esq,
of England &c.*

This Plate is humbly

Dedicated by Richard Blome

presentations of the true Sun in a Cloud, as Images in a Looking Glass.

XVI. How six Suns may be seen in this Circle. In such a Circle as this, there sometimes appear 2 Suns, sometimes 4, yea and sometimes 6. For let D E F G H I, be a great and round Cloud, the upper part whereof D E F, we suppose to be thicker, as being more exposed to the Wind and the Heat of the Sun. The Sun being sufficiently High to the South A, and the Eye of the Spectator K, 6 Suns may appear in this Circle: The first and chiefest at E, by Beams proceeding from the Sun A, at right lines: the second and third at D and F, by refracted Beams, that penetrate the Ice in those places; where its thickness decreasing by degrees, they are on both sides crooked or bent inwards. Whence it is that these two Suns cast a Red Colour towards their Circumference, on that side where they look towards E, where the Ice is thicker; and a Blew Colour on the other side, where it is more thin. The fourth at H, is seen by directly reflected Rays: And lastly, the fifth and sixth G and I, by Rays reflected to equal Angles.

XVII. How it happens that less than six Suns are seen. But in case the Spectator be not at K, but somewhere nearer to the point B, so as that the Circle, whose Center is supposed in his Eye, and to pass through B, do not cut the Circumference of the Cloud; then will not he be able to see the 2 Suns G and I, but only the other 4. And if on the contrary he go back much to H, or somewhat further to C, he will see 5 only, viz. D E F G and I, and removing much more backwards, he will see 3 only, and those 2 not contained within a white Circle, but as it were pierced with a white Cloud.

XVIII. What a Mock-Moon is. When such a like Image is beheld under the Moon it is called PARASELENE, that is, a Mock-Moon, which admits of a like application with that of the Mock-Suns already spoken of; for as a Mock-Sun is the Image of the Sun reflected in a Cloud; so is a Mock-Moon an Image of the Moon appearing in a Cloud. Such were those which appeared in the year 1671, the 25th of May about 11 a Clock at Night, when the Moon was very much declined towards the South, and near the Horizon.

CHAP. XXI.

Of Fire.

I. What Fire is. FIRE is a Company of Particles of the Third Element, moved with the most rapid motion imaginable. Or, it is a Lucid and Fluid Body, consisting of Earthly Particles, most swiftly moved by the matter of the First Element, upon which they swim, as it were.

II. Why Fire is said to be hot and shining. Fire is said to be hot, by reason of the various agitation of its Particles, whereby they are most rapidly agitated every way. It is said to be Lucid or shining, because the subtil matter, which agitates the Terrestrial Particles, is whirl'd round, whence whilst it endeavours to recede or withdraw it self, it presseth the Heavenly Globuli, in which perfection Light consists.

III. A variety of Fire. Nevertheless every Fire is not Hot and Shining; for there is one sort of Fire which is only shining, as in Rotten Wood and Glow-worms; and another sort which is hot only, as in Dung, and a third sort that is both hot and shining together.

Fire is only shining when the most subtil matter of the First Element running this way and that way in the strait pores of Earthly Bodies, which resist the entrance of any other matter, doth push forwards the Heavenly Globuli: or else when the said matter is in so small a quantity, that it can only press the Caelestial Globuli, which of their own nature are sufficiently incited to Motion, without being able to agitate the Terrestrial Particles. Again, the Fire will be only hot, when the subtil matter is in such abundance, that it can also agitate those Earthly Particles, but yet withal is so entangled with the Earthly and Watry Particles, that it cannot explicate it self, nor push forwards the Heavenly Globuli every way, in a right line. And Lastly, Fire is both shining and hot, when it is so at liberty as both to be able to press the Heavenly Globuli, and most swiftly to move the Terrestrial Particles.

Violent Motions are very proper to produce this effect, because the Earthly Particles, to which they communicate themselves, tho' they be at first encompassed with the Second Element, yet they move fast enough to drive them away from about themselves, and to admit nothing but the First Element, which much augmenting their agitation, doth dispose them soon to separate themselves from one another, and to take upon them the form of a Flame.

In order therefore to the kindling of Fire, that is, to the gathering such store of the matter of the First Element, as may both shine and burn, it is necessary that the Globuli be driven out of the Intervals of some Terrestrial Particles, which being afterwards separated from each other, and only swimming in the matter of the First Element, may be snatched away with its most swift motion, and driven every way. That this is so, we shall easily conceive, if we consider that the matter of the First Element doth in swiftness much exceed that of the Second Element, and that those little Bodies which swim amongst the particles of these 2 Elements, can only be carried along by the motion of the Second Element, for that its Globuli do break the force of the First Element, and resist its motion: whereas on the contrary, whilst those Earthly Bodies are surrounded with the matter of the First Element, they must necessarily comply with its agitation, in like manner as we see that a piece of wood is carried away by the swiftness of the stream wherein it swims.

Thus we find that the Brightness of a Flame is greater, and more conspicuous in a dark Place, than in one enlightened by the Sun; because in a place so illustrated, many Globuli of the Second Element from the Sun, are sent into the Flame, which lessen the agitation of the matter of the First Element, and consequently also the violence of the Fire. Whence also it is that when our Optick Nerve is strongly affected by the Fulgid Light of the Sun, the light of a Candle, compared with that of the Sun, seems to be none at all, as being scarcely discernable by our Eyes.

From what hath been said, we may gather the chief Qualities of Fire: for seeing that its particles are solid, and most swiftly moved, they cannot but produce heat, which, as shall be said in the following Chapter, is nothing else save the actual various motion of the little parts of the Body, affecting the

IV. What is the Cause of these various Fires.

V. Violent Motion produces Fire.

VI. Fire is kindled by driving out the Globuli from the Intervals of the Terrestrial Particles.

VII. Whence it is that the Brightness of a Flame is greater in a dark than in a light Place.

VIII. Why Fire is hot and shining.

the *sense of feeling*. And so also if together with this we call to *mind*, what before hath been said concerning *Light*, viz. that it consists in an endeavour of receding from the *Center*, or in the pressure of the *Heavenly Globuli*. For seeing that the subtil matter, that constitutes *Fire*, is constantly whirled round, and endeavours to recedethence, it cannot but procreate the *sense of Light*, and make the *Fire Bright and Shining*.

IX.
Of the several ways whereby Fire may be kindled.

Fire may be kindled several ways: First out of *Flints*, for they being of a hard substance, if other stiff Bodies dash against them, by this means the *Globuli* of the *Second Element*, because of the narrowness of the interjected space, are forced to march off, leaving only behind them the matter of the *First Element*, and so the *Earibly Particles* which swim upon it, and follow its motion produce *Fire* and are turned to *Sparks*. Which may be the Cause why we find that in *Subterraneous Places* *Fire* is often kindled. For since there is always in those places a *viscous slimy matter*, and many exhalations are sublimed there by the *Suns* heat, it may so happen that one *Flint* dashing against another, may send forth *sparks*, by which the exhalations that cleave to the kindled *viscous* or *sulphureous matter*, may communicate a *flame* to the *Bodies* that are nearest to them. Now that there are such fat and *sulphurous Flames* in the *Bowels* of the *Earth*, is well known to the *Miners*, and Reason convinceth the same; for seeing that there is a *Fire* in the *Bowels* of the *Earth*, there must be *Fumes* arising from it; seeing also that there are *sulphurous hot Bathes*, and *veins* of *Jews Lime*, and other oily matter boyling in the hidden Channels of the *Earth*, we may easily judge that from these also a continual *Smoak* or *Fume* must proceed by way of exhalation. And it seems probable, that the first kindling of those *Fires* which burn in *Mount Atna* in *Sicily*, and *Vesuvius* in *Campania*, hapned after this manner.

X.
How Fire is kindled by a Burning Glass.

There is also another way of kindling *Fire*, viz. when the *Beams* of the *Sun* are concentred in a *concave Glass*, for by this means the *Globuli* acting with their joint forces, do excite a various and vehement excitation of the *Terrestrial Particles*, whence proceeds a *Flame*, the *Heavenly Globuli* being beaten back, by the swift agitation of the *Terrestrial Particles*, so as that the *Particles* of the most subtil matter can freely flow together and continue this agitation.

XI.
Sharp Spirits can also kindle a Fire.

A *Fire* also may be kindled by *sharp Spirits*, as appears in *Hay*, which if it be laid up before it be sufficiently dry, it becomes hot by degrees, and at last breaks forth into a *Flame*, because the *Spirits* of *Herbs* that are shut up in it, have not so free an egress, as when they were *Green*, and before they began to be dried; and therefore being no longer able to enter into the same passages, with the *Globuli* of the *Second Element*, they become surrounded only by the matter of the *First Element*, which putting them into a most swift motion, makes a *Flame* to appear. But this never happens in *Wood*, tho' it be struck never so much, because its substance is not stiff enough, that by a concussion of another hard Body, the *Globuli* of the *Second Element* should be driven away, because the part that is struck bends towards another, before that the *Second* begins to bend towards the *Third*, and that again towards those that are next

to it, by which means its force of flying back is lost.

But forasmuch as *Flame* is perpetually turn'd to *Smoak*, and is no more the same than a *River*, which is continually supplied by an access of new waters, it is of absolute necessity that it have some *Food* or *Fuel* whereby it may be preserved and maintained. And this is no other but those *Terrestrial Parts*, which being agitated by the matter of the *First Element*, have a power to drive away the *Air* or any other *Body*, that might extinguish it: It is also requisite that these particles be very thin, that they may be able to supply the room of the vanishing *Smoak*: for the thicker particles are easily surrounded by the *Globuli* of the *Second Element*, and possessing themselves of the places which the particles of the *First Element* have left, do much break the force of the *Fire*, and choak its *Flame*.

For which reason also all *Oily*, *Sulphurous* and *Bituminous Bodies* are of all others most conducive to maintain and preserve *Fire*; for that by reason of the contexture of their *Branch-like* Parts, and their fit *Thickness*, they are most fit and disposed to be agitated by the particles of the *First Element*, and being thereby driven out of their places, to communicate their motion to other *Bodies* with such force as that they drive away the particles of the *Second Element*, which otherwise would extinguish the *Fire* into which they strive to enter on every side.

These things premis'd, it will be easie to conceive, that *Flame* is nothing else but a *Fire* wholly at liberty, that is, a *Fire* whose parts are so agitated, that they entirely separate themselves from each other, and do only swim in the matter of the *First Element*. It will be likewise readily conceived how a *Flame* is produc'd, by viewing the *Candle* A B, and reflecting that there be many parts of *Wax* that move very swiftly throughout the whole space C D E, where they constitute a *Flame*, because they swim alone in the matter of the *First Element*. We must also consider, that the parts of *Wax* that constitute the *Flame* do continually strive to mount still higher, for that by reason of their great agitation they are more light than the *Air*, that surrounds them, which having been forced to descend continually, endeavours to return to its place again, and to which indeed it would return, if the new particles of *Wax* that come forth from the *Wick*, and which begin to follow the Course of the *First Element*, did not hinder it; which is confirmed by experience, which shews us that as soon as the particles of *Wax* cease to proceed thence, or tho' they do, yet have not force enough, the *Flame* ceaseth in the space C D E, and the *Air* possesseth it self of its place.

It is peculiar to *Flame* to mount upwards, and to end in a sharp point: the reason whereof is, because the *Flame*, by reason of the great abundance of the matter of the *First Element* that is in it, being lighter than the *Air* that surrounds it, must of necessity tend upwards: and because the middle parts of the *Flame* G D E, are more strongly agitated by means of their greater solidity, than those which are about the utmost parts C C, whose motion is much diminish'd by the neighbouring *Air*, this makes the *Flame* to end in a point, and its *Smoak* to break forth chiefly at the top H, where the

XII.
How Fire is Nourish'd or Fed.

XIII.
Oily and Sulphurous Bodies are a proper fuel to preserve Fire.

XIV.
How Flame is produced.

Figure 59.

XV.
Why the Flame always mounts upwards, and ends in a point.

the *Terrestrial particles* begin to lose their agitation. As for Example, When the *Smoak* ascends towards H, it makes the *Air* to descend by I and K, towards B, where razing the *Wick*, it pushes the *particles of Wax* towards the *flame*, which serve to nourish it: Which Circular motion of the *Air* towards the *flame*, Experience shews us, in that when a *Chamber* is close shut, save only some little Hole or Chink, and a *Fire* be kindled in it, a *Wind* is perceived to enter in by the said Chink; and which is so much the stronger, by how much the *Fire* is greater.

XVI.
The force of Fire upon Earthly Bodies.

Fire is extremely active, and exerts its Force upon the *hardest Bodies*; for its *Particles*, as so many sharp *Needles* penetrate their *Pores*, and driving out the *particles* therein contained, they divide its *parts*, and turn them into their own Matter; and in case the *particles* of the *Bodies*, the *Fire* acts upon, are easily separable, then they *melt*. For to be *melted*, or in a *liquid* form, imports nothing else, but that the *Body* in that state consists of *Particles* that are divided from each other, and in some agitation. As on the other hand, *Bodies* are *dried*, when by approaching to the *fire*, their thin and slippery *Particles* are exhaled, the more thick *Parts* being left, which being thereby more closely joyn'd together, constitute *hard Bodies*.

XVII.
The Ventilation of the Air is necessary, to the preservation of Fire.

The *Ventilation* of the *Air* is necessary to *Fire*; because the *Air* being push'd upwards by the mounting *flame*, cannot enter into another place, which the *Fire*, by consuming its *Fuel*, leaves open for it; and whilst it thus succeeds, it like a *Fan* or *Bellows*, drives the *fire* into the more inward parts of the *fuel*, and dissipating those that are more *Heavy*, doth thus by blowing preserve the *fire*: For where this is not, and the *Air* is hindred from supplying the said place, the *flame* not being able to give way, becomes choak'd by the more heavy and gross *Fumes*.

XVIII.
Fire is extinguish'd by any Liquor poured upon it.

Fire is put out, when any *liquor* or *moisture* is poured upon it in a greater quantity, than can be put into motion by the force of the *fired Particles*; which is the Cause why a little *Water* increaseth the *Fire*, whereas a great deal of it doth put it out.

XIX.
Why the Air must have free access into a Chamber, that the Fire may not fill it with Smoak.

Hence it is, that when a *Fire* is kindled in a *Chamber*, if the *Air* hath no free access to it, the whole *Chamber* becomes presently fill'd with *Smoak*. Because the *Air* drives away from it great store of *Air*, together with the *Particles*, of combustible *Bodies*: For it is these that being mix'd with the *Air*, constitute the *Smoak*, as the more solid *Parts* of those *Bodies* are turn'd to *Ashes*. And since it is repugnant that there should be any *Vacuum* in Nature, it is necessary that so much *Air* enter the *Chamber*, as there is *Smoak* going out: For except this be, the whole *Chamber* will be fill'd with *Smoak*.

CHAP. XXII.

Of the Nature of Heat and Cold.

I.
Heat and Cold do not belong to any Species of Quality

HAVING already rejected all *Qualities* really distinct from their *Subjects*, we shall not trouble our selves with the enquiry, to what Species of these *Qualities*, *Heat* and *Cold* do belong. And the rather, because these *Forms* are unknown to us; and

if we should admit them, the Enquiry will still remain, by what Virtue they operate, if they be *Active*; and how the Sense suffers by them, if they be *Patible*. Wherefore it remains only for us to determine, to what *General Head* of things *Heat* and *Cold* do belong; viz. Whether they be *Substances*, or are only to be accounted amongst the *Modes* of *Substances*.

really distinct from the Subject.

Qualities that belong to Matter are nothing else, but certain dispositions in the *Subjects*, consisting in *Magnitude*, *Figure*, *Motion* and *Situation* of *Parts*, whence they produce several ways of Sensation: Tho' there be nothing in these *Bodies* like to those *Idea's* they awake or excite in us; so that tho' the *Particles*, for Example, of an *Hot Object* be otherwise dispos'd than those of a *Cold*, yet in neither of them is there any thing like to those *Idea's* or *Modes* of Sensation they stir up in us.

II.
Wherein the Nature of Qualities is general doth consist.

If any one therefore enquire, whether these *Qualities* are *Modes* existing in *Bodies*? We Answer that they are so, if they be taken for the various disposition of *Parts*; but not so, if they be taken for those *Modes* of Perception which they excite in us.

III.
Qualities are certain Modes in Bodies.

Heat therefore is a *Quality* arising from a greater and unequal Motion of the *Terrestrial Particles*: And *Cold* is a *Quality* proceeding from the quiet of the *Parts*, or at least from a less degree of Motion in them.

IV.
What Heat and Cold is.

We assert therefore, That *Heat* is nothing else, but the motion or agitation of the small *Parts* of a *Body*; and *Cold*, their rest or consistence. Now that *Heat* is nothing else, but motion, may be proved from its Increase and Decrease; for we find that *Liquid Bodies* become hot, when their *Particles* are put in motion by *Fire*. Thus we find that *boiling Water*, *melted Metals*, and all other things, when set on *fire*, are very much agitated, neither is *heat* to be perceived in them, till their *Parts* be put in motion. In consistent or compact *Bodies* we likewise find, that when they are struck or rub one against the other, provided it be done with some Force, (as when two pieces of *Wood* are rub'd against each other, or a *Knife* whetted upon a *Whetstone*) heat is excited in them both. For the *Heat* in any *Body* becomes increased, and grows stronger, by how much the agitation is greater. Hence it is, that nothing, amongst *Natural Bodies*, is more hot than *Flame* is, because nothing hath its *Parts* more agitated, as daily Experience teacheth. And if there appear any difference between one *Flame* and another, that proceeds only, because the *Parts* whereof they are composed, are more or less thick; and consequently more or less powerful to agitate those *Bodies*, on which they exert their Forces.

V.
Heat consists in Motion, and Cold in Rest.

When we say, That *Heat* is Motion; we are not so to be understood, as if the whole *Body* that is heated were agitated: For it is repugnant that the same *Body*, should at one and the same time be moved by various Motions; but only that the small particles thereof be in motion and variously agitated; that is, that they change their situation, and are differently apply'd to the different parts of ambient *Bodies*; so as to be tossed with various determinations, to the Right, to the Left, Upwards, Downwards, Forwards and Backwards, according to their several dispositions and figures.

VI.
All the Particles of Fire are moved, but not the whole Fire itself.

VII.
In what
sense Li-
quid Bo-
dies are
said to be
hot.

If any one Object, That according to this Explan-
ation it will follow, that all *Liquid Bodies*, as *Water*,
Wind, *Air*, and the like, are *hot*; because, as hath
been said in our *General Physicks*, their *parts* are
variously moved. For *Water* is no other ways
distinguish'd from *Ice*, but because its *parts* are in
continual *motion*; whereas those of *Ice* continue
always in the same situation.

VIII.
The An-
swer to the
foregoing
Objection.

Before I come to give a satisfactory Answer to
this Difficulty, I would have it noted, that every
agitation cannot be called *Heat*, but that only
which is of force enough to affect the Sense of
Feeling, and to shake the *Filaments* of our *Nerves*.
For if the *motion* be not strong enough to produce
this effect, we cannot give it the Name of *Heat*;
that being an *Appellation*, which is attributed to
things with relation to our *Senses*. Thus when a
Sound is so weak, as not to reach our *Ears*, tho'
it may wave the *Air*, it cannot be called a *Sound*.
And so to denominate any thing *hot*, it is requisite
that there be such a *motion* of the *Particles*, as to
affect the *Nerves* of our *Hand*, or some other
part of our *Body*. *Fluid Bodies* therefore, consi-
der'd in themselves, and without any respect to
our *Senses*, may be called *Hot*, tho' not *comparatively*,
that is, with reference to our Sense of
Feeling; except it should happen, that the *Par-
ticles* of our *Hand*, which is the ordinary *Organ*
of *Feeling*, be more slowly moved than the *Par-
ticles* of the *Body* that is felt: As it happens, when
with a *hot Hand* we touch a *Body* that is *Luke-
warm*, which then feels *cold* to us; and yet we
shall feel the same *Body* *hot*, if we apply our
other *Hand* that is *cold*. *Water* therefore abso-
lutely consider'd, may be said to be *hot*, because it
contains some *heat* in it self, and is capable of
being more *cold* by many degrees, as when it be-
gins to *freeze*: But with regard to our Sense it is
cold, because it excites no such Sensation as we
call *Heat*, in our *Organs*.

IX.
The Nature
of Cold
consists in
Rest

Having discover'd the Nature of *Heat*, we
cannot be ignorant of that of *Cold*: For as *Heat*
is the various agitation of the insensible *parts* of a
Body; so *Cold* is their *Rest*, or at least a diminution
of their *Motion*. For we find by daily Expe-
rience, that *Hot-water* grows by so much the
colder, as the Agitation of its *parts* ceaseth, till
at last, by a total Cessation thereof, it be changed
into *Ice*, which of all others is the most *cold Body*.
Thus the things that are said to be *cold*, are en-
dued with little or no Agitation, and consequently
are not able to move our *Senses*, but rather mode-
rate and put a stop to the *motion* of our *Animal*
Spirits. Thus, as long as our *Fingers* are warm,
we can do any thing with them; but when once
they are seiz'd with *cold*, they become useless to us
in the performing of any work.

X.
Why hot
things
take up
more place,
than such
as are
cold.

A *Hot thing* therefore differs from a *Cold thing*,
as a thing that is at rest or less moved, differs from
that which is *moved*, or more swiftly moved.
Whence it is that those *Bodies*, whose *Parts* are
agitated by *heat*, contrary to their Custom, cannot
be comprehended in so small a space or room, as
those which are at rest, or are less moved; for as-
much as by means of this *motion* their small *par-
ticles* are rendred *irregular*, which therefore require
more room, than when they are united, and are
not separated by any agitation.

Some suppose *Cold* to be nothing else, but a
Privation of *Heat*; but these seem not to have
understood the Nature of *Rest*; which is nothing
else, but an *abode in the same situation*: Now
Abode or Continuance, is something *Positive*, yea,
more *positive* than *motion* it self. For that which
is unchangeable, must without doubt more partake
of the Nature of an *Entity*, than that which con-
sists in continual Change and Vicissitude. Where-
fore we must conclude, that *Rest* or *Quiet* is a
positive thing, as having no less efficacy than
Motion. For which of the two shall we reckon
to be most positive; that which keeps together
and preserves other *Bodies*, or that which dissipates
and destroys them? Now it is the Property of
Rest to preserve many things, that by *Motion* are
spoil'd and damnified: Wherefore *Rest* ought to
be look'd upon as being more positive than *Motion*.
For who will assert, that to *abide in a place*, to
continue in time, to *rest in a Seat*, or the like,
which belong to *Rest*, to be less positive, than to
take a Journey, to *run a Race*, or to *be in a con-
tinual flowing*, which belong to *Motion*? Indeed
it is an Error of our Mind, whereby we take *Rest*
to be something *Privative*, and *Motion* to be *Posi-
tive*; because we experience, that the one depends
on our *Will*, whereas the other is scarcely taken
notice of by us.

It seems strange to some, that by *Rest* only,
which constitutes the Nature of *Cold*, *Rivers* and
Seas should be *frozen*, and the Life of *Animals*
should be destroy'd: And yet 'tis evident, that all
this is done by *Rest* alone, not the least of *Motion*
being to be found in any of these Effects. For
what doth the *freezing* of *Rivers* and *Seas* import,
but such a union and clinging together of their
parts, whereby they do consist and are at *rest*?
For no stronger *Argument* can be alledg'd to
prove, that any *Bodies* are joyn'd, than to say that
they lye at *rest* together.

For tho' a whole *Body* of *Ice* may be carried
along the *Water*, yet its *Parts* notwithstanding
are at *Rest* together; for in case they were in
agitation, then would they no longer constitute *Ice*,
but *Water*; as we find, that when the *Frost* breaks,
the *parts* of the *Ice* that lay still together before,
by being separated through *motion*, turn to
Water.

That *Cold* is the Cause of the Death of *Living*
Creatures, must not seem strange to us, seeing that
our *Bodily Life* consists in the various agitation of
the *Blood*, *Spirits* and *Humours*, upon the diminution
or cessation whereof, *Life* it self must cease
also. For as by too intense *Cold*, that is, by the
consistence of the insensible *Particles* of the *Air*
and *Water*, the *Water* that turns a *Mill* is con-
gealed; so the total cessation or diminution of the
motion of the *Blood* and *Spirits* in the *Bodies* of
Living Creatures, deprives them of *Life*. As we
find, that in the *Winter* time, *Flies* and many other
Living Creatures consume and *dye*, especially when
the *cold* is very intense.

As there is an *Actual Heat* and *Cold* found in
Bodies, so some *Bodies* are said to be *Potentially*
hot or *cold*. Those are called *Potentially hot*,
which have an *aptitude* or *disposition* to grow *hot*,
or *heat* other things; which ariseth from hence,
that their *particles* are so disposed, that they are
liable to be more violently moved by the *Subtil*
matter,

XL
Cold is
something
that is
Positive.

XII.
It is by
Rest alone
that Ri-
vers are
frozen, yea,
the Sea it
self, and
that Li-
ving Crea-
tures die.

XIII.
The parts
of Ice are
at Rest,
tho' the
whole may
be carried
along by
the stream
of the
River.

XIV.
Cold, as it
is a Rest
of the Parts
of a Body,
kills Li-
ving Crea-
tures.

XV.
What Po-
tential
Heat and
Cold is.

matter, which runs through all Bodies. Thus *Quick-Lime*, which is cold to the Touch, is said to be *hot Potentially*, because the *Subtil matter* can easily excite an Agitation in its Pores. In like manner all other Bodies, which can produce such a motion in the Particles of other Bodies, are said to be *Potentially hot*; such as are *Pepper, Ginger, Spirit of Wine*, and the like. And on the contrary, that Body is said to be *Potentially cold*, whose Particles cannot be agitated by the *Subtil matter*; or whose disposition of parts is such, as to hinder the particles of any Body to be put in agitation by others; such as are *Lettice, Vinegar, &c.*

CHAP. XXIII.

Of the various Effects of Fire.

HAVING hitherto consider'd the Nature of Fire, and how it diffuseth Light from it self through the Air, and communicates heat to those Bodies that are near it; it remains now that we explain some other of its Effects, viz. how it rarefies and condenses some Bodies, softens and melts others, and again hardens and dries; changeth some into Calx or Ashes, and others into Glass. In order to the giving of a Reason for these different Effects, we are to presuppose that Rule of the Philosophers; that Every Action is received, not so much according to the manner and condition of the Agent, as according to the Disposition of the Patient. The Action of the Fire is every where one and the same; but the difference of the Effect proceeds from the diversity of the Matter whereon it acts.

In the First place therefore, if a Body, whose Parts are pretty close together, be very much heated, let those parts be of what figure they please, provided only that they be not Round, whilst they are whirl'd about their own Center, they cannot but meet with their Corners, and push one another, and then such a Body is said to be rarefied; as appears in Milk, when it boils, as well as in other Liquors. The same may be often perceived in hard Bodies, which being heated, do lose few of their Particles by Exhalation. Thus Red-hot Iron is more turgid than that which is cold.

But in case the Parts of a Body be very light, and very susceptible of Agitation, and yet have some slight Coherence; yet so, as that they scarcely touch one another, and constitute a Whole, that is, of a very loose and incompact Substance, the least heat supervening to such Bodies as these, and communicating some motion to their parts, disposeth them to a nearer Conjunction, and by this means condenseth the whole Body: As when Heat reduceth Snow to a less bulk, by making the parts of it closer together.

The Fire softens Bodies, by agitating their Particles with so moderate a Motion, as doth only move them, without separating them from one another. Which happens only in those Bodies that consist of such parts, as are with equal facility separated from each other; as in Wax, a hot Hand, Lead, and other such like, whose insensible parts are not wholly without motion, tho' the slowness of it make it imperceptible.

The Fire melts Bodies, whilst it not only moves their Particles, but also separates them from each other, as to their situation. For by the violent agitation of the Fire, the particles of Bodies are separated from one another, and most swiftly moved. And accordingly Metals, tho' otherwise hard Bodies, are by the force of Heat melted, and resolved into Homogeneous Particles, as they are usually called.

A like Effect of Fire is DISTILLATION, by means whereof a Body is changed first into Vapour, and afterward, as that Vapour condenseth, is turn'd to Liquor: Which may be done several ways, according to the several degrees of Fire, as by the moist Heat, as the Chymists call it, which is that of a Balneum, or by the dry heat of Ashes, Sand, or a naked Fire. And by this separation of parts, there are distill'd from Bodies first Burning Spirits; then Phlegm or insipid Water; and lastly, a sharp and corroding Liquor, which by a very violent Fire is distill'd from Salts.

But if the agitation of the Liquid particles be so great, that some of them be carried upwards, or be changed into Air or Fire, and so requiring a greater Space wherein to dilate themselves, and to pursue their motion, do thrust other Bodies out of their places; then these Liquid Bodies become very hot and boil. Now this great Heat or effervescence is carried on with an equal motion, and without any great perturbation of their parts, when the said Liquid Bodies do not contain much Heterogeneous matter; as it happens in Wine and pure Water. But they boil, where the Matter of Bodies is more Heterogeneous, partly spirituous and volatile, and partly thick and clammy, or ropy: These being the two Matters that concur to the making of Bubbles; for viscous and clammy Matter, serves to make the Skins of the Bubbles, and the volatile Matter furnisheth that Aery Spirit that fills and distends them. But if the agitation of the Heat be not strong enough to overcome the Heaviness of Bodies, then it cannot dilate those Bodies, so as to make them take up a greater Space. And therefore it is, that the particles of Metals do not fly up into the Air, because the force of Heaviness that is in them, surpasseth the Activity of the Fire.

As the Fire softens and melts some Bodies, so it hardens and dries others, viz. such as are compounded partly of thin, flexible, slippery and volatile Parts; and partly of Thick and Branchy parts mix'd together, but not very firmly sticking to one another. For that Body is said to be dry, which wants those fluid Particles, which when united together do constitute Water, or any other Liquor. Such Bodies as these therefore, as soon as they come near the fire, their fluid and thin Particles being exhaled or turned into Vapour, become dry, and their thick and branchy Particles are left alone by themselves; which being more nearly and closely joyned, and with greater firmness hanging together, do constitute hard Bodies. As is manifest in Clay, some of the pores whereof are by heat shut up, and others again dilated and left more open.

Another Effect of Fire is, that it separates most Bodies either into a kind of Calx, or into Ashes, according to the various application thereof. For when those Bodies that are apt to melt, are so placed

V.
How Bodies are melted by the Fire.

VI.
How Bodies by Fire are resolved into Vapour, and afterward turn to Water, or other Liquor.

VII.
How Bodies come to heat and boil, by means of Fire.

VIII.
How it comes to pass, that the Fire hardens and dries some Bodies.

IX.
How Fire turns Bodies into a Calx and Ashes.

I.
Some Effects of Fire remain still to be explained.

II.
How the Fire rarefies Bodies.

III.
How it condenses them.

IV.
How Bodies grow soft by the force of the Fire.

placed, as that a violent flame of Reverberation may beat upon them, they become turned into a *Calx*. For all *Hard Bodies*, which by the Action of *Fire*, are reduc'd to a powder, by expulsion of some of their thinner *Particles*, which joyned the other parts together, are said by the *Chymists* to be turned into a *Calx*. So that *Calcination* is an Operation, whereby a mix'd Body, especially *Stones* and *Metals*, are reduced into a small Powder. Neither is there any other difference between *Ashes* and a *Calx*, save that *Ashes* are the Remainers of those Bodies, whereof a great part hath already been consumed in the fire: Whereas a *Calx* is of those Bodies, which suffer little or no diminution at all by the Action of fire, as not being inflammable. And both of them agree in this, that they consist of solid and thick Parts, such as by the ordinary force of the fire cannot be changed into *Vapours*, and are of irregular and many Corner'd figures; so that they only lye upon one another, without sticking close together, and probably do not touch one another, but in some very small Points.

X.
How these
Calces, and
the Ashes
of Bodies
are by Fire
turn'd into
Glass.

If afterwards these *Calces*, or the *Ashes*, are committed to a strong and long continued Fire, their Corners or Angles, which are the cause of the Roughness and Opacity that is in *Ashes*, become bended, by which means the particles being agitated and tost together, are at last more closely joyned, polished, and made more smooth, which touching each other only, according to little Surfaces, do constitute that hard, transparent and brittle Body, which is commonly called *Glass*.

XI.
Why Glass
is hard,
stiff, trans-
parent, and
brittle.

GLASS is a hard and stiff Body, because it consists of thick and inflexible particles, which are not joyn'd together by any intangling of the Branchy parts, but by contact only. It is *Transparent*, because after its concretion or coagulation it still retains its Pores, through which the Heavenly Globuli can continue their motion to Right Lines, according as they were moved before, when it was *Liquid*. Lastly, It is *Brittle*, because the Surfaces, in which its particles touch one another are very small.

XII.
How Earth-
quakes are
caused by
Fire.

Fire not only exerts its Activity upon the Surface of the Earth, but also in the Cavities or Inward parts of it; where it is the cause of *EARTHQUAKES*, as often as any great store of Exhalations are found there: Not that they of themselves are able to produce this effect, seeing their Particles do only constitute the Air; but because they easily mingle themselves with the more Subtil particles of Spirits, and being heated and kindled by them, seek for a larger place wherein they may dilate themselves; and being not able to find that, they shake all that stands in their way: Much in the same manner as Gun-powder, shut up in a Mine, as soon as it is kindled, by endeavouring to make room for it self, makes a great Concussion, making the Earth to quake. Which is the reason why those places are most subject to Earthquakes, which abound with Veins of Saltpeter, Brimstone, or other Oleaginous matters; these being easily kindled by Spirits, or by any spark of Fire, from the dashing together of Stones or Flints. And as soon as they are kindled, not being able to contain themselves in the same Space, they are carried upward, and break

through their Prison Walls, to make room for themselves.

EXHALATIONS, kindled in the Holes of the Earth, do break forth outwardly on the Surface of it, when they are of force enough to make a way for themselves thro' the outward Crust of the Earth; but when they are not of strength enough to do this, they only cause a simple Earthquake, that is, they only make the Country round about to rise a little; as Gun-powder raiseth the Terrasses that lead to the Mines. An Earthquake therefore is nothing else, but the Shaking of any Place or Country, which is accompanied sometimes with a breach of the Ground, and a terrible Noise.

FERMENTATION is accounted amongst the Effects of Fire; and happens, when the Matter of the first Element is so shut up in the narrow Pores of Earthly Bodies, that tho' many thick Particles swim in their little Spaces, yet are they so agitated by some Watry and Airy particles that are insensibly mix'd with them, as to be able to affect our Nerves, and produce the perception of Heat. Such a fervescence or rising is found in Dough, and in the working of New Wine, Beer, and other potent Liguors: So likewise in Oil of Vitriol, mix'd with Salt of Tartar; Aqua-fortis, in which Copper is put, and other such like. Because the Particles of these Bodies are so agitated by the *Aethereal matter*, that runs through their Pores, as not only thereby to be heated, but also rarefied and subtiliz'd; so that the Hooks and Intanglements, whereby their Particles before were held and kept together, are dissolved. Fermentation therefore is nothing else, but the adventitious and expansive Motion of the insensible Heterogeneous parts of fermenting Bodies, excited without any sensible Cause.

Bodies subject to Fermentation are not of one kind; for they may be either *Animate*, or without Life, Thin or Thick, Natural or Artificial, provided they do consist of Heterogeneous parts. Now this Heterogeneity of parts is found in those Bodies, which are compounded of Particles, whereof some are in continual motion, and others again are Earthly, thick, and more fix'd, which hinder the more Volatile parts from flying away. For on this contrariety and strife of the Parts fermentation chiefly depends; for where the Particles are of the same figure and conformation, no fermentation can be excited. Thus we find, that New Beer, or Wine, when shut up in narrow Mouth'd Bottles do ferment or work with such Violence, that they often break the Bottles: Whereas if the parts of these Liguors be separated by distillation, they will no longer be capable of fermentation. For which Reason, Stillatitious Oils, burning Spirits, and distill'd Waters, will continue a vast while without the least change by fermentation. Thus Spirit of Wine, shut up in a Bottle, is very far from falling into a fret or effervescence; but if you add some Oil of Turpentine to it, it excites such a commotion of the parts, as endangers the breaking of the Bottle, in case it be close stoppt.

CHAP

XIII.
Subterra-
neous Fires
are differ-
ently.

XIV.
What Fer-
mentation
is, and the
Cause of
it.

XV.
Heteroge-
neous Par-
ticles are
required
to the
Motion of
Fermenta-
tion.

IV.
The
of the
paces
concer-
ning
Mist

V.
The Peri-
steticks
fired.

CHAP. XXIV.

Of the Mixtion of Bodies: As likewise of their Changes, Conversion, Generation, Corruption, Alteration, Augmentation and Diminution.

I.
There is a
twofold
Mixtion of
Bodies.

THAT it may be the better apprehended what *Mixtion* is, we are to observe that things may be mingled after a twofold manner; the first way is, by a *Composition* or rather *Apposition* of the things to be mingled. The second by their *Coalition* or *Confusion*.

II.
What Ap-
position and
Confusion
is.

Those *Bodies* are said to be mingled by *Apposition*, whose parts do not wholly mix and run through one another, but only *superficially* touch one another, keeping their distinct natures, as when *Fruits* of several sorts are heaped together, and make one heap. But the *Mixtion* by *Coalition* or *Confusion* of *Bodies* is, when they are so mingled, as that they wholly run through one another, so that there is not the least *particle* assignable in the *mixt Bodies*, which doth not consist of every one of them. According as some think that the parts of *Water* pour'd into *Wine*, are so thoroughly mixed with the parts thereof, as to be susceptible of the same *Action* and *Passion*. This last kind of *Mixtion* *ARISTOTLE* seems to defend *lib. 1. de Generat. cap. 10.* where he asserts that a new *substantial form* is produced in *Generation*, and that there is no part of the *mixt Body* so small but is mixed.

III.
Aristotle's
mistake
about the
Mixtion of
Bodies.

But this opinion of *Aristotle* is not at all probable, for if we should suppose the most perfect *mixtion* of all the most minute parts of a *Body*, this would destroy the very nature and notion of *mixture*; since it is the common notion of *mixture*, that the *things* mixed must still continue; for if they do not abide, then it is not a *mixture* of several things, but a *destruction*. Besides, if the *parts* of a *Mixt Body*, do wholly through and through pierce one another, so as to be coextended every way, then two *Bodies* will be in the same place, seeing there is no part so small that is not mixed, and that is not partaker of all the parts both in *substance* and *quality*. From hence also it will follow, that a small *Body*, by example a *Pint* of *Water*, will be equal and coextended to a far greater *Body*, viz. a *Gallon* of *Wine*, seeing that there is no part so small, which does not consist of *Wine* and *Water*.

IV.
The opinion
of the Peri-
pateticks
concerning
Mixture.

Some *Aristoteleans*, to avoid these absurdities, tell us, that all *Miscibles* are not of the same *Power* and *Virtue*, and that the weaker do yeild to the stronger. So that when a drop of *Water* is cast into a *Hogshead* of *Wine*, it produceth no *mixture*, but that the form of the weaker part, viz. *Water*, is by the more powerful *Wine*, changed into its own nature, so that by the addition of this drop of *Water*, the *Wine* contained in the *Hogshead* is encreased one drop.

V.
The Peri-
pateticks con-
futed.

But this Evasion doth not agree with Reason; for I will only demand of them, whether this drop of *Water* cast into the *Hogshead* be changed into *Wine*? They will say it is. But if after this first drop, another and another be put in, and this continued, till the first quantity be 2 fold, 10 fold, 100 fold, 1000 fold encreased, what will be the kind or substance of this *Liquor* then? The *Peri-*

pateticks according to their *Principles*, must say that the whole *Mass* of this *Liquor* will be pure *Wine*, tho' instead of one *Gallon* of *Wine*, a 1000 of *Water* may have been pour'd into it drop by drop, since according to them, every drop of *Water*, by the overpowering quantity of *Wine*, was turned into *Wine*. But is not this absurd? If they will not own this, let them tell us when the *Wine* began to lose its form; and at what particular drop of *Water*, the whole *mass* of *Water* became deprived of its form. But here they must be silent, and tho' fore against their wills, acknowledge their *Ignorance*.

Wherefore rejecting this *Sentence*, we must adhere to the former, and maintain that the *Mixtion* of *Bodies* is performed by the apposition of *particles* to each other: Thus when *Wine* and *Water* are mixed together, the parts of each *Liquor* continue in their distinct natures; so as that the *particles* of *Wine* and *Water* are not in the same, but in distinct places, as black and white *Threads*, in the Weaving of any *Stuff* or *Cloath* do each possess their distinct intervals. Neither must it seem contradictory to what we here assert, that the mixture of *Wine* and *Water*, cannot be perceived by our *Senses*, because the *particles* of *Wine* and *Water* are so small and subtil that they cannot be perceived by our *Sight*, nor distinguished by our *Tast*.

And certainly we have great reason to believe that *Mixtion* is performed after this manner, since we find that *Bodies* that are mixed may be separated again from each other. Thus *Wine* that is mixed with *Water* may be separated from it, either by a *Sponge* dipt in *Oyl*, or by a *Cup* made of *Ivy*, or by extream *Cold*, which freezing the *Water*, leaves the *Wine*, or at least the most *Spirituous Part* thereof in the center of the *Icy mass* unfrozen. And the same is almost perceived in every *Body*, wherein there is but a little quantity of *Sulphur* and *Spirit*; for if you distil out of *Vitriol*, *Tartar*, *Salt peter* and the like, their *Phlegm* and *Acid Spirit*, and after distillation, put them again to the remaining dregs, which the *Chymists* call their *Caput Mort*, you will find the same *Body* restored, which was before distillation, and almost of the same quantity or bigness as it was before. *Chymists* observe that when they mix the *Spirit* of *Vitriol* with the *Salt* of *Tartar*, there at first happens a great effervescence or ebullition, and when that is over, both the *Liquor* and *Salt* do quite lose their sharpness and acrimony, so that the *Body* remaining after this their effervescence, is a meer insipid *Body*: But if then by distillation you separate the *Spirit* of *Vitriol* from the *Salt* of *Tartar*, you'll find that neither of them are deprived of their former *virtue* and *force*, but that they are as sharp and corrosive as before. All which *Experiments* do give us an undoubted evidence, that things after mixture retain the same nature they had before, and that *Mixture* is performed by *Apposition* of the *Particles* of one *Body* to those of another.

Mixtion therefore or *Mixture* is nothing else but the *Collection* of divers *Bodies* into one, and that by way of *Apposition*. It may be performed divers ways. 1st. By *Percolation* or straining; thus *Blood*, *Urin*, *Medicinal Waters*, *Stones*, almost all *Juices*, *Wine*, *Oyl*, &c. are made.

VI.
That Mix-
ture is
caused by
Apposition.

VII.
Experi-
ments pro-
ving Mix-
tion to be by
Apposition.

VIII.
What Mix-
ture is, and
how many
several
ways it may
be made.

2ly. By *Coltion* or by *Baking*, thus *Salt*, *Bricks*, *Earthen ware* and *Glass* become one mixt *Body*. 3ly. By *Sublimation*, thus *Soot*, *Snot* or *Snivel*, and, it may be *Metals* also, and some *Salts* used by *Chymists* are made. 4ly. By *Distillation*; as many sorts of *Water*, *Rain*, *Dew*, *Manna*, and other things are made. 5ly. By *Dissolution*, thus *Salt-water*, the *Chyle*, or *nutritive Juice*, and dissolved or melted *Bodies* are made. 6ly. By *Exhalation*, as *Flame*, *Steams*, *Clouds* and other such like. 7ly. By *Concretion* or growing together, as *Snow*, *Frost*, *Hail*, the *Stone* in *Mans Body*, &c. 8ly. By *Calcination*, as many sorts of *Salts*, *Ashes*, *Quick-lime*. 9ly. By *Simple Commixtion*, as *Wine* mingled with *Water*, *Ointments*. 10ly. By *Simple Expression*, as *Wine*, *Oyl*, and most other *Juices*.

IX.
The Changes of Natural things.

Mutation or *Change* is the *Vicissitude* or *Alteration* of any thing, but chiefly of such as are bodily. The nature whereof we shall the better apprehend, by taking notice that all *Changes* are of two kinds, viz. *Accidental* or *Essential*. An *Accidental Change* is that whereby only some *Accidents* are changed, which do not constitute the essence of a thing, such as are the changes of *Heating* and *Cooling*. *Essential Changes* are those wherein the essences of things are changed by the *Introduction* of a *New Form*, and by depriving them of the *Form* they had before. And forasmuch as according to what hath been said in our *General Physics*, there are in the usual sense of the *Peripateticks* no substantial *Forms*, besides the *Soul* of *Man*, it follows that neither can there be in their meaning any *substantial change*, save that in the production of *man*, because in no other production, any such new *substance*, as they understand, is made; but in all *Alterations* and *Generations* the *matter* or common *Subject* is only *Accidentally* or *Essentially* modified according to *Measure* or *Quantity*, *Rest*, *Motion*, *Position* and *Figure*.

X.
What Conversion is.

To be more particular, *Conversion* is that *Action*, whereby one thing is changed into another, by the *Alteration* of its former *Modification*, and the introduction of another, diverse from the former, the same common *Subject* still remaining. It is said that the same *Common Subject* remains: For the *Matter* which is the *Subject*, is numerically the same after the *Change*, as it was before, being only *Modified* anew. And this is well to be observed, because that otherwise it will not be any true *Conversion* or *Change* of one thing into another, but rather an *Exchange* of one thing for another.

XI.
The difference between an Accidental, Essential and Substantial Conversion.

That *Action*, which is terminated in those *Modes* or *Accidents* that may be present or absent without the destruction of the *Subject*, is called an *Accidental Conversion*. But that which is terminated in that peculiar *Modification*, which is *Essential* to any thing, and doth distinguish it from all others, the same is called an *Essential Conversion*, and sometimes *Substantial*, inasmuch as it affects the very *substance* or *subject* it self, so and so modified. For indeed by the *substance* of any thing we are not to understand that bare *Entity*, which is conceived to be the *Subject* of the *Form*, and to be specified by it, but both *Subject* and *Form* taken together, to wit, that *Thing* which consists of them both, or rather the *Subject*, as I said, it self, as considered with its peculiar *Modification*: So that

when this *Constitution* or *Modification* is changed, and another introduced into the common *Subject*, it is evident that then the former *substance* is also changed, and turned into another. Thus when that peculiar *modification*, which constitutes the nature of *Wood*, is changed, and the *Essential* disposition that constitutes a *Stone* is introduced, in this case we must say that the *Wood* is *essentially* and *substantially* changed into a *Stone*. And so likewise in the case of *Nutrition*, when *Corn* is reduced to *Flower*, that to *Bread*, and the *Bread* into the *Blood* and *Flesh* of our *Bodies*, this I say is an *Essential* and *Substantial Conversion*.

So likewise *Generation* is nothing else but a certain disposition of *matter* according to the foresaid *Modifications* of *Measure*, &c. as in the Production of *PLANTS* and *BEASTS*; because in the generation of either of these, a new *substance* is no more produced, than in the framing of a *Statue*, or the building of a *House*. Now what happens to *Stone* or *Wood* when it is framed into a *Statue*, more than a new form or habitude in the matter of *Wood* or *Stone*? So likewise in the building of a *House*, there is no other change but what ariseth from the joining of *Stones*, *Boards*, *Tiles*, *Nails*, &c. which before were separate, but now being set together make such a composition or structure as hath the form of a *House*. And tho' the framing of a *Statue*, and the building of a *House* do terminate in a *Substance*, for both the *Statue* and *House* are *Substances*, yet no new *Substance* other than I have before asserted, is found in either of them, there being nothing superadded to them besides a new *Modification*, with which both these *Substances* are affected. Accordingly, *Generation* is nothing else but a translation or new ranging of the parts of *matter*, which is alike in *Natural* and *Artificial Compositions*.

As for *Corruption*, it is nothing else but the dissolution of parts that were before united. Thus as a *House* is said to be destroyed when its several parts are separated from each other; so *Wood* or other combustible *matter* is said to be corrupted or destroyed, when by *Flame* it is resolved into *Ashes* and *Smoke*. The Cause of the *Corruption* of *Bodies* is when strange particles, by thrusting themselves into their pores, do thereby change and destroy the *Texture*, *Connexion* and order of their *Parts*. Hence it is that those *Bodies* that have less pores, are for the most part more durable than others, and less subject to *Corruption* or *Destruction*.

Alteration is nothing else but the change, whereby a *subject*, still abiding the same, becomes changed as to some *Accidents*. So *Water* is said to be altered, when it is heated by the *Sun* or *Fire*: and a *Man* is said to be altered, when of *Healthful*, he becomes *Sick*, and of *Ignorant*, *Learned*, &c. Because *Man*, by supervening *Sickness* or *Learning* is not changed into another thing than he was before. And therefore *Aristotle* in the 1st. Book of *Generation* chap. 4. defines *Alteration* to be that whereby a sensible *subject*, abiding still the same, becomes changed in its affections.

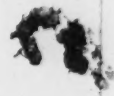
Augmentation or *Growth*, to speak properly, is nothing else, but *Nutrition*, whereby more *substance* is restored, than was lost or dissipated. For *Augmentation* is never performed without local *Motion*, since nothing can grow or encrease, but by the

XII.
What Generation is.

XIII.
What Corruption is.

XIV.
What Alteration is.

XV.
What Augmentation or Growth is.





To the Right Hon.^{ble}
Newport of Bradford,
Shropshire Treasurer
Household, and
of their Ma-
jesty's Privy



Francis, Viscount
Lord Lieutenant of
of their Majesties
one of the Lords
Majesties most Ho-
nourable Privy Councill &c.^a

This Plate is humble

Dedicated by Richard Blome

the access or apposition of *aliment* to its parts, and by the union thereof with them. Thus when the *Innate Heat*, and *Temperament* of the *Body* are such, as that more prepared *Food* or *Aliment* is added to it, than it has lost, that *Body* is said to grow or encrease. As when a *Tree* by the *Juice* it draws out of the *Earth* grows taller, and spreads wider.

Heat, as happens in those that are *Old*; or because the said *Heat* is too strong, as in those who are of a *Cholerick Temperament*; or when the *Body* is so disposed, that it cannot be supplied with sufficient *Food*: Or lastly, when the little *constitutive parts* of the *Body* begin to waste and are consumed, whatsoever may be the cause of it; for then the *Musculous Parts* fall down, and grow *Flaggy* for want of a sufficient accession of new *Substance*, caused by a too sparing supply of *Food*, or because the same is not fitly prepared or concocted. Whence we understand that *Augmentation* or *Growth*, and *Diminution* do consist in *Local Motion*.

XVI.
What Diminution is.

The *Diminution* or *Decrease* of *Bodies*, is when this *Nutrition* ceaseth, and when less *Substance* is restored than has been dissipated or lost. The *Cause* of *Diminution* is, either the want of *Food*, or when the *Food* is not such as is proper to feed the *Body*; or because of the weakness of the *Innate*

The Seventh Part

OF THE

INSTITUTION

OF

PHILOSOPHY.

OF

LIVING CREATURES

In General: And Specially of

PLANTS and ANIMALS.

The INTRODUCTION.

Of the Division of Living Creatures.

I.
The Division of Bodies into such as are living and destitute of Life.

Hitherto we have considered the Nature of *Inanimate Bodies*, whether hid in the *Bowels* of the *Earth*, or exposed in the Face of the *Heavens*. And now we proceed to *Living Bodies*, viz. *Plants* and *Animals*, which are comprehended under this *General Notion*, because they are endued with *Life*, and are furnished with *Instruments* appropriated to *Nutrition*, *Growth* and *Propagation*. For all *Bodies* in the *Universe* are either *Living* or *devoid of Life*. Amongst those that are without *Life* are reckoned the *Heaven*, the *Stars*, *Fire*, *Air*, *Water*, *Earth*, *Metals*, *Stones* and *Fossils* or things dug out of the *Earth*: So that of all the *Creatures* contained in the *World*, *Plants* and *Animals* only are endued with *Life*.

II.
What Living Bodies are.

Now we call those *Living Bodies*, that have received from the *Author of Nature* such a *Disposition* of an *Organical Body*, as that by innumera-

ble passages and conveyances it hath, the *Alimentary Juice*, being by motion thrust into them, is by the *Soul* every way dispersed and distributed, for their *Nourishment*, *Growth* and *Conservation*. They are called *Living Bodies* from the *Life* they possess, and *Animate Bodies* from their *Soul*.

This *Soul*, a fit *Disposition* of *Parts* being first supposed, chiefly consists in the *Innate* or *Inborn Heat*, which is a *Heating*, but not a *Shining Fire*, generated in *Bodies* at their first *Production*, by means whereof the *Alimentary Juice*, for their *conservation*, is duly prepared, and distributed throughout the whole *Body*, and joined to the several parts of it, for a supply of that which daily wastes away, by which means *Vegetation*, that is, *Nourishment* or *Nutrition*, and *Encrease* or *Growth* are performed. And therefore this *Soul* is called *Vegetative*.

The *Life* flows from this *Soul*. For if the *Heat* be preserved and maintained by convenient *Moisture*, as its proper *Food*, then that *Body* is said to *Live*; and on the contrary to *Die* or *Perish*, when *Cold* and *Driness* do so predominate in it, as that the *Inborn Heat* becomes thereby diminished or quite taken away.

III.
What the Vegetative Soul is.

IV.
Why a Body is said to live and die.

N n n Now

V.
There are
two General
Heads of Living
Bodies,
Plants and
Animals.

Now forasmuch as *PLANTS* and *ANIMALS* do both of them enjoy the common degree of *Life*, and resort under *Vegetable* as under their Immediate *Genus* or *General Head*, we must first consider their *Affections*, and whatsoever doth in general belong to them; as for Example, wherein chiefly the *Nature of Living Bodies* doth consist; how such as are *Vegetable* differ from those that are devoid of *Vegetation*; what that *Heat* is whereby they are *Oberished and Live*, and whence their difference is deriv'd. For there are two *General Heads* of *Living Bodies*; the *First* whereof are those, which according to their outward and inward *shape* exhibit a *substance* equally extended; and wherein from the top to the bottom we perceive but one and the same progress of *Nature*; so that all their *parts* are nourished, grow and are generated, without any distinction in their *operations*; their *Bodies* being as so many *Channels* and *Pipes* through which the *Food* is transmitted, and in which it undergoes several changes. And these are called *PLANTS*, which draw up an *Alimentary Juice* out of the *Earth* by their *Roots* into the *Stem* or *Stalk*, which from thence is convey'd and sublim'd to all the utmost parts.

VI.
The Definition
of a
Plant.

A *PLANT* therefore is a *Living Body* furnish'd with a *Skin*, *Strings*, *Root*, *Stalk* or *Stem*, and other *Organical Parts*, and is nourish'd, grows and produceth its like from prolifick *Seed*, only by means of a *Vegetative Soul*. So that all these *Plants* which spring out of the *Earth*, or grow in standing *Pools* or *Water*, or elsewhere, provided they grow and are nourished, whether they have *Roots* or not, whether they have *Leaves* or not, whether they have *Flowers* and *Fruit*, or have only a *Root*, all these, I say, are called *Plants*.

VII.
Plants are
divided
into Trees
and Herbs.

But forasmuch as the name of *Plant* doth not only belong to those *Bodies* which grow out of the ground by their *Roots*; but also to all those that grow upon other *Plants*, or that spring out of the ground some other way; therefore *Plants* by a general division may be distinguished into *TREES* and *HERBS*, as the two members that comprehend all *Plants*. A *Tree* is a *Plant* rising out of the ground with a *woody Stem* or *Stalk*, and growing up to considerable *Height*. An *Herb* is a *Plant* consisting of *Leaves* and a *tender Stalk*, never rising to the tallness or thickness of *Trees*. Some *Authors*, besides these 2 members, place a *SHRUB* as a third thing between a *Tree* and an *Herb*, but, as it seems, without any necessity, forasmuch as there be no *Plants* but may be conveniently reduced either to *Trees* or *Herbs*; a *Shrub* being nothing else, but a *Tree*, which rising out of the *Earth*, variously spreads it self into *Branches* and *Leaves* from the *Root*. For a *Shrub* riseth higher from the ground than an *Herb* doth. As to *Mushrooms*, &c. they may be reckon'd amongst those *Plants*, that grow upon other *Plants* or spring forth at their *Roots*. To which also may be referred some *Plants*, which do not spring out of the *Earth*, but from other *Plants*, such as are those small *Strings* that grow upon *Pulse*, and being intangled with them are carried upwards into the *Air*. As for *Moss* it may be well called an *Excrementitious Plant*, because from its original *Seed* it grows upon barren *Ground*, and *Stones* it self, in which its spreads its *Roots*.

VIII.
The Division
of Plants into
Wild and Domestick,
or such as are cultivated at home, and

those that are *Outlandish*: Not but that all *Trees* as to their first original may be called *Wild*, as having grown first wild in the *Fields*: but because there are many *Trees*, which men do not take the pains to *Transplant* and *Cultivate* in their *Gardens*, and if they should, yet would not they thereby change their wild *Nature*, whereas others being *Transplanted* and *Cultivated* by the industry of men, are much improved thereby.

The Second General Head of *Living Bodies* are such as consist of a far greater variety and multiplicity of *Parts*, have peculiar *motions*, and seem to constitute many *whole Bodies*, which yet are joined together with that proportion, as to produce proper and necessary *motions*; so that from these different *Parts*, certain *Machines* or *Engines* do arise, most curiously wrought and contrived, which are called *Animals*, whose members are not only complete in themselves, but are also joined with that exact *Symmetry* and *Proportion*, as to conspire to the Good and Profit of the *Whole*, and concur to one *motion*. And notwithstanding that in the *Prædicamental Line*, and the *Genealogy of Things* and *Modes*, an *Animal* is, according to the common way of *Philosophizing*, constituted by something *Sensitive*, which is true too, in a certain meaning; yet we are to take heed that we do not by these means attribute to an *Animal* such a *Soul* and *Sense*, as has *Perception*; since the *Sense* of an *Animal* purely and alone consists in the impression of the *Object* on the *Bodily Organ*, which may be done without the Help of a *Soul*.

Animals are divided into such as *fly* in the *Air*, *swim* in the *Water*, *go* on the *Earth*, *creep*, *slide*, *along*, or such as are altogether *immoveable*. They may likewise be distinguished from the difference of their *Generation*, *Parts*, *Actions* and other such like. And accordingly some are *Viviparous*, such as bring forth *Living Creatures*; others *Oviparous*, which lay *Eggs*, out of which *Animals* afterwards are hatched. As to *Parts*, some have *Wings*, others *Fins*, some go on two *Feet*, others on four or more. And others again want all these. As to their *Actions* or *Manners*, some are *Tame*, others *Wild*; some *Domestick* and *Sociable*, others delighting in *Solitude*; some *Stupid* and *Dull*, others *Quick* and *Cunning*. As to the places where they are bred and live, some are *Fiery*, others *Aquatick* or *Watry*, and others *Terrestrial*. Some live both on the *Earth* and in the *Water*, which are therefore called *Amphibious*; some are *Subterraneous*, or living under *Ground*, &c.

The most Noble and Excellent of all *Living Creatures* is *MAN*, for the handling of whom we design the Eighth Part of our *Institution*, as being the Complement of all *Animals*, and to express my self, as some of the *Ancients* have done, the *Horizon of Heavenly and Sublunary Creatures*. Now forasmuch as these *Living Things* do agree in some *affections*, we will here first touch upon those, which are common unto them all; and then in *special* apply our selves to the Contemplation of *Plants* and *Animals*, and shall at large set forth the distinction that is between them.



[Faint, illegible handwritten text, possibly a signature or a short note, located below the main drawing.]



To the Right
 Denis Hampson
 Buckinghamshire
 Oxfordshire
 This Plate is humble



Worshipfull S.
 of Taplow in
 & of Bradwell in
 Baronet
 Dedicated by Richard Blome

CHAP. I.

How Living Bodies differ from those that are Inanimate, and destitute of Life.

I. The word Life is taken in a threefold signification.

II. What a Life of Simple Existence is.

III. What an Active, or Actuous Life is.

IV. What the Life of Existence with another is.

V. Of the difference that is between Living and Lifeless things.

IT appears from what hath been already said, that *Living Bodies* differ from *Lifeless things* in this, that the one have *Life*, and the other are devoid of it. But forasmuch as the word *LIFE* is *Equivocal*, and attributed to things that are said to *Live* under different Notions; we must first consider what *Life* is, and how many significations it admits of. For the *Notion of Life* is very various and vagrant, but reducible to 3 General Heads. Sometimes we make use of this word to signify *Simple Existence*; sometimes, *Active Existence*; and sometimes also, *Coexistence*, or the *Duration of one thing with another*.

That is a *Life of Simple Existence*, when the word to *Live* is taken simply for *Existence*: As when *BOETHIUS* defines *Eternity*, an *All at once* and *perfect Possession* of an *Interminable Life*. And in the same meaning *ARISTOTLE* calls the *Life of Animals*, their *Being*; because when they *die*, and cease to *live*, he thought they ceased to be also.

An *Actuous Life*, is a *Life of Existence*, accompanied with *Action*; and in this Sense *Life* is taken for *Action* and *Operation*. Thus *Fire*, or a *Candle*, whilst it sends forth a *flame* is said to *live*; and so the *Vital Spirits* are said, to *live* in a *Body*, as long as they are in continual *motion*, and flow through the *Veins* and other hidden *Channels*. Thus we call *Spring-water*, *Living*, because it bubbles up, and flows continually; but *Dead*, when it stands still, and is without *motion*. In like manner, *Love* is said to be *alive*, whilst it is strong and active. So *Virgil*, in *1st Aeneid*:

— with *Lively Love*
Strives to fore-stall.

The *Life of Existence with another* is, when *Life* is taken for the *Duration* of one thing with another; or for the *Duration* of some *Substance*, in conjunction with some *Accident*, whereby it is perfected. Thus the *Life of Man* is commonly said, to consist in the *Conjunction* of *Soul* and *Body*, and his *Death* in their *Separation*: As when *CATULLUS* saith, *Let's Live my Lesbia*: Where, by the word *Live*, he understands *Existence* in conjunction with *Joy* and *Pleasure*. So that *Life* taken in this Sense, consists in the union of two *Substances*; or in the union of a *Substance* with some *Accident*, from which it borrows some kind of *Perfection*.

Living things are chiefly distinguish'd from *Lifeless things*, by the *Life of actuous Existence*, or because they are endowed with a certain *Efficacy* and *Activity*: For their *Life* properly consists in *motion*, which the Purest part of the *Blood*, if they be *Animals*, or of the *Alimentary Juice*, if they be *Plants*, communicates to the grosser parts of their *Bodies*: So that we find that *Plants* and *Animals* do soon perish, when the *Blood* by its *Circulation* ceaseth to quicken the *Members*, and when the *Juice* does no more enter through the *Pores*. For as *Bodily Life* consists in *Motion*, so *Death* consists in *Rest* or ceasing from *Action*. But for all this, we must not suppose, that there are any *Immaterial Souls* in *Living*

Bodies, that perform these *motions*, and the *Functions of Feeding and Growth*; it being sufficient that their *Parts* be so disposed, as that the prepared *Alimentary Juice* may freely enter into their *Inward parts*, and by its apposition, restore and supply their dissipated *Substance*. Now all this may be done by *Motion* alone, provided only that the *Parts* be rightly disposed, and that there be an equal *distribution* of the *Juice* by means of *Heat*. I say therefore, that *Living Bodies* differ from *Lifeless things*, in that the former, by reason of the want of *Organs*, cannot admit such a *distribution of Aliment*, for the *Restoration* and supply of what is lost.

If so be any one demands, by what *Force* or *Activity* this *Juice* is diffused through the *pores* and *passages* of the *Body*, to all its *parts*, so as that they grow not only in *length*, but also in *breadth* and *depth*?

I Answer, That this is done by means of *Heat*, proceeding either from the *Sun*, or from *Fire*. For such is the *Efficacy* of the *Heavenly matter*, that is, of the *first and second Element*, that by passing through the thicker *Particles* of the *third Element*, it doth agitate them, and in so doing doth produce or excite *heat* in them; by which means these *particles* being rarefied, are carried upwards through the *Pores* of the *Roots*, to the *Stalk* or *Trunk*, and all other *parts*. Besides, there is in all *Living Bodies* a certain *Inborn* or *Native heat*, or rather a *fire* that is *hot* only, without *Light*; by the assistance whereof the *Alimentary Juice* is distributed through the whole *Body*, and joyn'g it self to it, doth preserve, enlarge and perfect it.

Living Bodies also differ from such as are *Lifeless* or *Inanimate*; because these latter are not determin'd to any certain *figure*. Thus *Stones* may subsist under any *figure*: Some are 6 Corner'd, as *CRYSTAL*; some have a *crooked Surface*, as *FLINTS*; some have a *plain surface*, like a *Plate*, as *TALCK*; some have the *figure* of a *Lozenge* or *Quarry* of *Glass*. So likewise *Metals*, and all other *things* dug out of the *Ground*, do not require any *One precise figure*. But *Plants* and *Animals* cannot admit this variety of *figures*, as requiring a certain and determinate *Conformation*. For a *Plant* cannot be of any *figure*, but must have such a one, as is necessary for the drawing, concocting, digesting, and distributing of its *Aliment*. And 'tis for this Reason, that *Living things* only are furnish'd with *Organical Bodies*, which consist of such *Instruments*, as are proper to perform the several *Functions of Life*; such as are the *Root*, the *Stem* or *Stalk*, the *Branches*, the *young Shoots* in *Plants*; and the *Feet*, *Belly*, *Head*, *Bones*, &c. in *Animals*. Wherefore also a greater *Beauty* is found in the *Bodies of Living things*, than in *Artificial*; for since *Beauty* consists in *Variety*, it is evident that in *Living Bodies* there is a much greater diversity of *Parts*, than in others, whose *parts* are not so numerous, nor so fine and curious, nor so exactly and neatly joyn'd together.

Altho' in an *Artificial Engin*, or *Machin*, as likewise in a *dead Carcase*, or a *wither'd Plant*, there be many such like *Organs*, as are found in *Living Bodies*; according to what *Historians* relate of that *Wooden Eagle*, made by *REGIOMON-*

VI. By what force or virtue the Alimentary Juice is distributed through the Pores of Living things.

VII. Lifeless Bodies are not subject to any certain figure, as Living Bodies are.

VIII. Artificial Bodies are not capable of Growth, and Nourishment.

MONTANUS, which did fly in the *Air*, and shewed the way to the *Emperour*, as he was going to *Nuremberg*; and of the *Wooden Venus*, made by *DÆDALUS*, which could walk by the Artificial putting of *Quicksilver* into the Inward parts of it: Yet for all this, *Living Bodies* are very distinguishable from such *Artificial* or *Dead Bodies*; because they are nourished and grow, by the *Alimentary Juice* admitted into their *Pores*; whereas *Artificial* and *Dead things* are neither capable of *Growth* nor *Nourishment*.

IX.
Living
Bodies are
productive
of their
like.

Lastly, Herein also are *Plants* and *Animals* differenced from *Metals*, and other *Dead Bodies*, in that they can produce their like, and preserve their kind by a successive propagation of *Individuals*; which things dug out of the *Earth* are not capable of, as being destitute of *Seed*, or any *Virtue* whereby to generate an Off-spring.

CHAP. II.

The Life of Bodily things consists in Moisture and Heat.

I.
Living
Bodies
stand in
need of
Heat and
Moisture.

Forasmuch as such is the Constitution of *Living Bodies*, that they consist of several fibres or small threads, between which lye many large Conduits or Passages, through which the *Alimentary Juice* is strained, and diffused into all parts; it cannot be question'd, but the *Life* of *Plants* and *Animals* is supported by 2 things, viz. *Heat* and *Moisture*, which mutually stand in need of, and assist each other. For *Moisture* is the food of the *Heat*: And accordingly *Physicians* tell us, that *Life* consists in *Moisture*, as its *Passive*; and in *Heat*, as its *Active Quality*; and that all *Vegetative Bodies* do subsist and are preserved by the same.

II.
The Fire
that is in
Living
Bodies, is
Hot only.

But to remove all Difficulty that might arise from the word *Heat*; we are to take notice, that we do not speak here of a perfect *Fire*, which is both *hot* and *bright*, but of that which is *hot* only; such as is found in *Horse-dung*, and putrifying *Hay*: Which is therefore distinguish'd from the *Celestial fire* in the *Sun*, and from the *Elementary*, which burns upon our *Hearths*; because it doth not consist as those fires do, of *Particles* that swim in the first *Element*, and are tost with a vehement *Motion* within themselves; but proceeds from a kind of *fermentation*, caused by a mixture of *Heterogeneous* little *Bodies*. Tho' indeed, if we well mind its *Operations*, we shall find it to differ from the 2 former fires, *Solar* and *Culinary*, rather in degrees, than in nature and essence.

III.
There is a
twofold
Tempera-
ment in
Living
Bodies.
The one
according
to Justice.

But forasmuch as *Fire* is very *Active*, and cannot long be preserved without food, we find that *Moisture* is of absolute necessity required for its preservation and support. From hence ariseth the Temperament of *Living Bodies*, when *Heat* and *Cold*, *Moisture* and *Drought*, are so temper'd and proportioned, that none of these *Qualities* hinder each other, but with an agreeing *Discord* harmonize together. And this kind of Temperament is by *Physicians* called, a Temperament according to *Justice*, when these *Qualities* are so mixed, that the *Heat* in *Living Bodies* is qualified by *Cold*, and the *Moisture* by *Drought*, according to the requirings of each particular *Nature*. Because the same Temperament is not always found in

Living things, but is changed according to the variety of *Ages*, or the several Stages of *Life*. For in *Animals*, to every different *Age*, a different Temperament is appropriated; to *Childhood*, a *hot* and *moist* Temperament; to *Youth*, *hot* and *dry*; to *Manly Age*, *cold* and *moist*; to *Old Age*, *cold* and *dry* Complexion. And these Temperaments are therefore said to be according to *Justice*, because they of Property and Justice belong to such and such *Ages*.

To this Temperament another is opposed, which is called a Temperament according to *Weight*, wherein all the *Qualities* are in an Equal poise; so as *Heat* doth not exceed *Cold*, nor *Cold*, *Heat*: *Moisture* doth not exceed *Drought*, nor *Drought*, *Moisture*; but are altogether equal in degrees. But it does not seem probable, that any *Body* is posselt of such a Temperament, neither is there any Cause assignable that might thus temper and poise these *Qualities*; and therefore this is a Temperament in Notion only, as *GALEN* saith, and not Real.

IV.
The other
according
to Weight.

Forasmuch therefore as *Heat* and *Moisture* are required to a due *Vegetation* of *Living Bodies*, it happens, that according to the Exuperance of either of these *Qualities*, a more abundant production of *Living things* is occasioned. Thus in *Summer time*, when *Heat* bears sway, abundance of *Magots* breed in *Flesh*, *Bees* in the *Carkass* of an *Heifer*, *Humming-Bees* or *Drones* in that of an *Ass*, *Hornets* in that of a *Mule*, and *Wasps* in the *Carkass* of an *Horse*: It is in the same Season also, that *Dead Flies* recover *Life*. And accordingly it will not be difficult to give a Reason, why *Spices* grow only in *Hot Countries*, because they stand in need of a great degree of *Heat* before they can arrive to that Purity, by a separation of the *Heterogeneous particles*, that so the *Homogeneous* may come together, and constitute those *Odoriferous Bodies*. And therefore, as my Lord *VERULAM* tells us, *Trees* planted on a *hot-Bank*, and exposed to the *South* and *South-East*, do bud sooner than others, and bring forth more early fruit. And the same he saith of *Trees* planted near the *Wall* of a *Chimney*, wherein continual fires are kept; and that it is good for the same purpose, to let the *Branches* of *Trees* spread into those places where frequent fires are used. Of which we have a pregnant Instance in *Vines*, which according as they are more advantageously situated, do by a whole *Months* time, sooner than others, bear *Ripe Grapes*.

V.
The in-
crease of
Living
things, is
from Heat.

It is for this very Reason, that *Country-men* do *Dung* their *Grounds*; not only because the *Dung* doth fatten the *Earth*, whereby more plentiful Nourishment is convey'd to *Plants*; but also because by its warmth it comforts and refresheth the *Ground*, which was weak and languishing by reason of cold. For the *Dung* of *Animals* is *Salt*, and contains an *Inward heat*. And accordingly we find, that those who desire to hasten the springing and growing of their *Plants*, do take care very well to *Dung* their *Gardens* and *Plots* of *Ground*, before they sow their *Seed*. To this end also they pour stale *Urine* at the *Roots* of *Vines*, to make them more fruitful.

VI.
Dung, by its
Heat, doth
hasten the
springing
of Plants,
and makes
the Ground
fruitful.

As store of *Heat* doth conduce to the great increase of *Plants* and *Fruits*, so much *Moisture* also is a great help to the multiplication of them, when

VII.
How *Mois-
ture* is a
cause of the
increase of
Living
things.

when accompanied with convenient *heat* and *warmth*. Thus we find, that in *Moist* places *Grass* grows thicker, and riseth to a greater height, than in *Dry Grounds*. In like manner we see, that *Herbs* will grow in *Glass Vials*, fill'd only with *Water*. We find also, that the *Hair* of *Young-men* and *Children* grows much faster and thicker, because *Moisture* abounds in them: And *Trees* and *Plants*, that are much *water'd*, do thereby thrive the more; for by frequent *watering*, the *Dryness* of the *Soil* is temper'd, and the *Roots* are softned, and thereby made more fit to suck the *Juice* out of the *Ground*, and to send it up to the utmost *Branches*. So the fittest time for the *watering* of *Plants*, is the *Evening*; because the *Cool* of the *Night* following, gives the *Moisture* leave to sink down to the *Roots*, and refresh them.

How greatly *Moisture* conduceth to *Germination*, may be gather'd from *Moss*, which delights in *moist places*, and grows even upon those *Rocks* and *Stones* that are continually *water'd* with *Springs*. Hence it is also, that *Bread* that is kept in a *moist Cellar* grows *Mouldy*, and many other things that are laid up in *moist places*.

As an equal *Temperature* of *Heat* and *Moisture*, is the Cause of the great increase and multiplication of *Living things*; so the Excess of either, and more especially of *Heat*, is hurtful to them, and hinders them from arriving to their due *growth*. Thus we see that *Bodies*, wherein the *inborn heat* predominates, are of a low *stature*, because it consumes the *Moisture* too fast, not suffering it to spread and diffuse it self; and so also such *Persons*, in whom *Heat* abounds, are commonly *lean*: Whereas on the contrary, those in whom this innate *Heat* is weaker, and allay'd with *Moisture*, are apt to grow *fat*, and spread in *bulk*; as is evident in *Women*, who commonly are more *Plump* and *Fat* than *Men*, except *Sickness*, or any *Præternatural Cause* hinder the Effect.

CHAP. III.

The Death of Living things proceeds from contrary Principles, viz. from Cold and Driness.

Forasmuch as contrary Effects proceed from contrary Causes, we may easily conclude, That the Death of Living Creatures are owing to Cold and Driness. For as the Bodily Life consists in the due Temperature of Heat and Moisture; so Death happens to them through the predominance of Cold and Drought, whereby the Vital Principle of inborn Heat, becomes weakned and destroyed. Bodily Life, as hath been said, consists in continual Motion; wherefore when any Cause happens to fore-slow, or put a stop to this Motion, Life must cease also. Now, since nothing is more opposit to Motion, than Rest, wherein the Nature of Cold doth consist, it cannot be question'd, but that where Cold prevails, Death must enter. Thus we see Flies dye at the approach of Winter; and that Frogs, tho' they live in the Water, and are in a great measure habituated to Cold, yet perish in Frosty-weather. For as great Cold doth congeal the Waters, and hinder their Motion; so the over-slow agitation of the Spirits and Humors in the

Body of Man, is hurtful to the Life of the Body; and where it is of long Continuance, quite destroys the same. And in like manner also, excessive Cold causeth the dying of Plants and Trees.

For tho' Heat and Cold be contrary Qualities, yet do they by opposite ways produce the same Effect, viz. Drought. For we find that Clay is dried by hard Frost, as well as by great Heat in Summer: The Reason whereof is, because all liquid and moist Bodies, lose the agitation of their Particles, by Cold, and by this means become hard and dry: And therefore it is no wonder, if Clay, which is nothing else but a Mixture of Water and Earth, should grow hard and dry, because the Water which softned it, is by the cold congealed. Seeing therefore that cold works the same effect in Plants, it cannot seem strange to us if Plants perish, when the Juice wherewith they were nourished, is frozen. It has been of Old told us, that extream Cold scorcheth and burns up Plants, by congealing and drying up their Moisture and Alimentary Juice.

Hence also it is, that in Cold Countries the Leaves begin to fall from the Trees towards the latter end of Autumn; because about that time, the pores of Plants are shut up at the approach of Cold, and the Passages along which the Juice is conveyed, are dried up and contracted.

And as Cold produceth these Effects in Living Bodies, so doth excessive Heat also; for Heat exhausts the Spirits and Humours, and attenuates and wastes the Bodies in which it doth predominate. For as a Mill, without the assistance of Wind or Water, stands still without any motion at all; so Plants, upon the consumption of their Alimentary Juice, perish; and Animals, when their Spirits and Humours are weakned by extream Heat, languish and are slowly moved. Whence it comes to pass, that when great Heats happen in Hot Countries, at the time when the Ears of Corn begin to break forth, they are stopped in their coming forth; because the Moisture being by the heat dissipated into the Air, the Heat finds nothing to feed upon, or whereby to maintain it self.

The Death therefore of Living Bodies happens, when Moisture, which is the food and fuel of Heat, is wasted; or when Heat is separated from, and leaves the Moisture, which then ceaseth to be agitated, and distributed to all parts of the Living Body. For as Flesh laid before a slow fire, is roasted, and by exhaling of the greatest part of its moisture becomes quite dried up; so the Temperament of Living Bodies becomes spoiled, when the Spirits and Humours are alter'd and wasted by excess of Heat. Thus Fruits are frequently spoil'd by over-much heat, which scorching their outside, leaves their inward substance raw and unripe; as it happens to Grapes and other Fruits, whose outside is often scorched with that heat, which scarcely toucheth their Inward parts: As Bread put into an Oven that is over-heated, hath its Crust burnt up and scorched, whilst the midst of it wants baking, and is doughy.

But you'll say, If Driness be the Cause of Death, how can Fishes that live in the Water, ever arrive to that degree of Drought, which may cause their perishing or death? I answer, That the Water in which the Fishes swim, cannot hinder the waiting and drying up of their Natural moisture: As

II. Cold drieth as well as Heat.

III. Why the Leaves of most Plants fall in Autumn.

IV. Heat is hurtful to the Aliment of Living Creatures.

V. When the Death of Living Creatures happens.

VI. How Fishes are dried up in the Water.

VIII. Mouldiness proceeds from Moisture.

IX. Heat, when excessive, is hurtful to Living things.

I. Wherein the Death of Living things doth consist.

we find that *Flesh*, which is suffer'd to *boil* in a Pot full of *Water*, till all the Natural moisture be consumed, becomes harder than that which is *roasted*. Yea, we find also that some sorts of *Wood*, that have lain long in the *Water*, are found drier and lighter when they are taken out, than when they were put in.

VII.
Excess of
Heat is an
Enemy to
all Bodies.

Neither is excessive *Heat* only an Enemy to *Living Bodies*, but even to all in general: Thus we find that when the *flame* of a *Candle* or *Torch* is increased, it doth so much the sooner consume and waste the *Body* that serves it for *fuel*; and by a parity of Reason, when the *Heat* either outward or inward exceeds, it procures the *Death* of *Living Bodies*: As we find that *Plants* wither by excessive *heat*; and that *Men*, by indulging themselves in the *drinking* of *hot Liquors*, do hasten their own *Death*.

VIII.
Death
sometimes
is caused
by the
want of
Food.

Sometimes *Death* happens to *Living Bodies* by defect of *Food* convenient; as when *Nature* ceaseth to furnish them with *Matter*, whereby they might grow and be nourished: For so in *Plants*, tho' it may be there wants no *Moisture* for the *Heat* to act upon, and tho' the *Sun* have force enough in *Summer time*, to draw up the *Juice* out of the *Earth*; yet is not that *Fervescence*, or *Fermentation* of the *Alimentary Juice*, which is requisite to their *Vegetation*, always performed alike; for it requires a certain and determinate Season of the *Year*, which being once past, it cannot afterwards be expected. An Example whereof we see in *Quick-Lime*, which upon the affusion of *Water* causeth an *Efferescence*; but that being once ceased, it cannot be renewed again, tho' you should pour never so much *water* upon it. And for this cause it is that ripe *Fruits*; as *Apples*, *Pears*, *Plums*, &c. do fall down to the *Ground*, as soon as their *Stalk*, whereby they were joyned to the *Tree*, begin to want *aliment*, and those *fibres* that held them fast are dried up. And the same is the Reason, why all other *Fruits* and *Grains* fall out of their *Husks* and *Pods*.

IX.
The Destruction
of
Bodies, is
sometimes
caused by
a too great
opening of
the Pores.

And much like Effects do sometimes proceed from the too great relaxation and opening of the *Pores* of *Bodies*: For thereupon the *Bodies* contained in those Intervals must needs fall down, except that by some means or other their *bulk* be coextended to the amplitude of the *pores* wherein they are. Thus, when in the *Summer Season* the *pores* of the *Skin* are more open, the *Hides* of *slay'd Beasts*, have the *Hairs* more easily pluck'd off. Thus likewise it seems probable, that the falling out of the *Teeth* of *Children*, is caused by the dilatation of the *Sockets* of the *Jaw-bone*, wherein the *Teeth* are fixed; for they growing wider, as the *Child* advanceth in bigness, they can no longer keep the *Teeth* steady. But in *Old People* this falling out of *Teeth* is caused by the defect of *Aliment* and *Moisture*; because the *fibres*, through which the *Aliment* was used to be convey'd to them, grow dry and are contracted.

CHAP. IV.

What is the Cause of that Hardness, which is observ'd on the outside of living Bodies.

I.
Whence the
Hardness
of the

The *Hardness* of *Bodies* consists chiefly in this, that they resist the *Touch*, and that their parts are not easily separable from each other.

And forasmuch as this Resistance to the *Touch* is perceiv'd on the outside of *Living Bodies*; it will be worth our enquiry, What might be the Cause of it, that when their Inward substance is so soft, their outside should be hard. Whereof no other Cause seems assignable, but this, That the Outward parts of *Living Bodies*, are expos'd to the continual impulse of other *Bodies*. For it is certain, that the *Heavenly matter* (under which Name we do not only comprehend the Matter of the *first* and *second Element*, but also the *Air*, with the *Particles* of the *third Element* that are mix'd with it) carries the *Earth* round; and forasmuch as all these Small *Bodies* cannot pass through the *Earth*, or any of the *Bodies* which belong to it, it cannot be otherwise, but that vast numbers of them must dash against *Living Bodies*, and by their continual beating upon them, render them *hard*. For by this impulse, their Outward parts are driven closer together, and so become more Compact and Hard.

For to speak properly, the *Hardness* of *Bodies* is nothing else, but the *Rest* of many *Essential* or *Integral parts*, caused by the Pressure of the *Air*, or of the *Subtil matter*; which acting only on the outside, doth so much drive those *Particles* inwards, that they can no more be separated, without a perception of some Resistance. For tho' the *Subtil matter* doth penetrate all *Bodies*; yet we are to consider, that the Parts of many *Bodies* are so great and irregular, that they are able to resist its Action and continue at *Rest*, and by this means constitute *Hard Bodies*; because they resist or oppose their being divided, and are outwardly so compress'd by the *Air* and the *Subtil matter*, that it is oftentimes more easie to move them altogether, than to separate them from one another.

This is the Cause of those Coverings, which do invest some *Living Bodies*; as we find that *Acorns* have *Cups*; *Nuts* have *Shells*; *Beans* and *Pease*, *Pods*; and *Trees*, *Barks*: So likewise *Fish* have *Scales*, and some of them hard and stony *Shells*; as *Oysters*, *Crabs*, *Lobsters*, &c. All which without doubt are formed, by the continual impulse of outward *Bodies*; much in like manner as we find, that the *Palms* of the *Hands* of *Delvers* and *Ditchers*, by continual handling of the *Spade*, grow very hard; and as the *Soles* of our *Feet* become brawny and thick *Skin'd*, by assiduous beating against the *Ground*.

They are the same Causes also that produce *Hardness* in *Inanimate Bodies*. For *Snow* laid near the *Fire* becomes harder and more compact; and the outside of *Bread* becomes hardened to a *Crust*; and so likewise the outside of *Flesh* roasted, broiled, or *fryed*, grows harder than the inside. Neither can any other Reason be given, why *Broath*, *Boil'd Milk*, and other kinds of *Supping Meats*, presently after they are removed from the *Fire*, get a *skin* or *film* on the top of them, but this, that the agitation of the *Heat* is diminished by the contact of the *cold Air*, and in a manner quite stop'd.

Hence it is also, that the *Surface* of all *Liquors* is smooth and even; for tho' the Parts of *Water* be uniformly moved, as well as the *Air*, which immediately toucheth them; yet because the parts of the *Water* are moved after another manner, than those of the *Air*; and that the *Subtil matter*

Surface of
Living
Bodies
doth pro-
ceed.

II.
Whence the
Hard-
ness of any
Bodies doth
consist.

III.
Whence the
Coverings of
some Li-
ving Bo-
dies do
proceed.

IV.
The same
is the Cause
of the
Hardness
in Inani-
mate Bo-
dies.

V.
The Surface
of Water
is smooth,
and more
difficultly
divided
than its
inward
parts.

matter which surrounds the parts of the *Air* is quite otherwise moved than that which swims amongst the particles of the *water*; by this means the surface of either of them becomes smooth, much after the same manner as when two Hard Bodies are rub'd against one another; only with this difference, that this smoothness is with much more ease produced in liquid Bodies, because of the easie and ready Mobility of their Parts. And this is the reason also why the surface of the *water* is divided with more difficulty, than its inward parts.

VI.
The Hard-
ness of Bo-
dies some-
times pro-
ceeds from
Cold.

Cold also conduceth much to the Hardning of several Bodies: for we see that the surface of *water* in a *River*, by cold is congealed, whilst that which is at the bottom, by reason of the stronger motion of *heat*, suffers not the least alteration; and so also are many other Bodies sometimes hardned by cold, and thereby attain that degree of firmness, which is caused in them, by other Bodies beating upon them: For frozen *Fruit*, if it be put into cold *water*, and set in a warmish place, will appear covered over with a Crust of *Ice*, and in like manner the *Flesh* of *Beasts* or *Fish* that is frozen, if it be set in a warm place covered with *Snow*, there will appear a hard Crust of *Ice* on the surface of it.

VII.
But more
naturally
from Heat.

But tho' cold may sometimes contribute to the hardning of Bodies, yet this effect may with greater Right be attributed to *Heat*, whose property it is to agitate the parts of Bodies, and bring them closer together, by exhaling their superfluous moisture. Thus a Body exposed to the Beams of the *Sun*, as by this means it becomes better digested and riper; so likewise it attains a greater degree of firmness and hardness. This is manifest in *Apples*, *Pears*, *Cherries*, *Plums* and such like, whose outside by the *Heat* of the *Sun* becomes hardned, and covered with a *Skin*.

VIII.
All these
ways are
reducible to
one general
way of
Hardning
of Bodies.

But which way soever this Hardness may be produced in Bodies, it seems that they are all reducible to one general Cause, forasmuch as their outward parts endure the impulse of other Bodies rushing against them and dashing upon them, and by hindring their ingress, do resist and beat them off.

CHAP. V.

Of the Different Degrees of Heat in Living Bodies.

I.
There is a
different
degree of
heat in Li-
ving Bo-
dies. First
according
to the Di-
versity of
Age.

THO' Living Bodies may be distinguish'd according to the External Heat that Acts upon them, as they are in Countries or Places nearer or farther from the *Sun*: yet may they much better be differenced by that Internal Heat, which produceth divers Effects in them with relation to their Age, Sex and Nature. For as to their Age, it is evident that Heat in Living Bodies is not always in the same state and vigor. For in Infants and Youth the natural Heat is much weakned by the abundance of moisture, that it cannot exert its full strength; which is the reason why Infants are so prone to sleep, and apt to shed tears. But in the Height and Vigour of Age, the Heat is more strong and active; and the moisture being much lessened, the Spirits become more hot and fiery. For which cause those who have attained to Manly Strength, are more strongly inflam'd and Amorous,

whereas in Old Men, by the decrease of heat, and the increase of cold and driness, their natural faculties are much weakned and decayed.

Difference of Sex also produceth great diversity of Heat; for Females are commonly of a more cold and moist complexion than Males. Which difference is observed in Plants; for those are accounted Female Plants, which are more cold and moist, and have less virtue and strength; so that tho' they bring forth Flowers, yet for want of Heat they don't produce either Fruit or Seed. Whereas the Male Plants are more beautiful, as to their outward appearance, and have both Fruit and Seed. And for this cause it is, that the Female Plant delights in the Company and Proximity of the Male; according to what PLINY relates of the Palm-tree, which by some influence proceeding from the Male, doth conceive and become fruitful, and as soon as the Male, which stood near it, is cut down, dies presently.

II.
Secondly
according
to the dif-
ference of
Sexes, and
what the
difference
of Sex in
Plants is.

Amongst Animals also the Females are much colder and moister than the Males. As may be gathered from hence, that Males generally exceed Females in Bulk and Stature, as appears in Men, Pheasants, Peacocks and the like. The Males in Birds are commonly more beautiful and pompous for their Feathers. Amongst fourfooted Beasts the Males and Females are diversly distinguish'd; thus He-Goats have Horns, which their Females want; and Rams have greater and more crooked Horns than the Ewes. Cocks are adorned with Combs, and armed with Spurs; whereas Hens have in a manner no Combs at all. And in general all Males have a stronger and deeper Voice than Females, who generally have but a shrill and weak voice. All which effects cannot be better assign'd to any other cause, than to the greater degree of heat which is in Males, beyond that which is in Females. And the same may likewise be gathered from hence, that Males, in their tender years, whilst their inborn heat is overpowered with too much moisture, do much resemble Females, neither is any difference in their Temper to be discern'd between them. So likewise guelded Animals do more resemble Females, for the same defect of heat.

III.
Amongst
Animals
the Females
are colder,
than the
Males.

Another instance of this diversity of Heat in Males and Females is this; that Men, during the Winter Season, are more Brisk, and Women on the contrary, in the Summer and hot weather. The reason whereof is, because the Vital Spirits, which are in continual motion in a hot and dry complexion of Body, such as Mens are in the hot season of the Year are more dissipated; but in a cold season are more condensed, and thereby better preserved. Whereas in cold and moist Bodies, such as those of the Female Sex generally are; the Heat of the Summer cherisheth and excites the Spirits; and the cold of the Winter doth render them dull and sluggish.

IV.
Why Men
in the Win-
ter time
are more
brisk, and
Women in
Summer.

There is also a distinction and difference of Heat with relation to the different kinds of Living Things. And accordingly Physicians distinguish Heat into 4 degrees: They call that the First Degree of Heat, when that Quality is somewhat predominant above the rest that are in the mixt Body: The Second when the Heat sensibly discovers its predominance in the Body: The Third, when it strongly and powerfully displays it self;

V.
Of the four
degrees of
Heat that
are in Li-
ving Bo-
dies.

self: And the *Fourth* when that *Quality* is prevalent in the highest degree. Thus amongst *Plants*, *Borage*, *Flowers of Betony*, *Beets*, *Sweet Almonds*, &c. because they impart some small effect of *Heat* to a well tempered *Body*, are said to be *Hot* in the *First Degree*. *Smallage*, *Betony*, *Balm*, *Rosemary*, *Wormwood*, *Saffron*, *Sage*, *Cinnamon*, &c. because they produce a moderate *Heat*, and that very sensibly, are called *Hot* in the *Second Degree*. And because others impart a strong *Heat* to those that take them, as *Origany*, *Hyssop*, *Celandine*, *Mints*, *Radish*, *Mother of Tyme*, &c. they are accounted *Hot* in the *Third Degree*: And last of all, because *Garlick*, *Pepper*, *Mustard*, *Cresses*, *Pellitory of Spain*, &c. communicate a much more vehement degree of *Heat*, they are called *Hot* in the *Fourth Degree*.

VI.
Animals
are distin-
guish'd ac-
cording to
their sever-
al degrees
of Heat.

This Distinction of *Heat* is not only observable in *Plants*, but also in *Animals*. For we see daily that those *Excrements* which remain after that the *Meat* hath been digested by the heat of our *Stomachs*, serve for food to *Hogs* and *Hens* after having pass'd through a new *Fermentation* in them; and that the remainders thereof being laid to the *Roots* of *Plants*, are consumed again by the *Heat* of the *Sun*, leaving only the grosser parts behind them. Which different changes could not be wrought upon those *Excrements*, if there were not different degrees of *Heat* in the *Bodies* of *Living Creatures*, forasmuch as that which can no further be wrought upon by the *Fermentation* of our *Stomachs*, may yet be further altered and digested by a new *Fermentation* in the *Stomachs* of other *Animals*. Thus a *Mass* of *Dough* that hath been fermented by *Leaven* or *Yeast*, tho' it cannot be made to rise again with the same *ferment*; yet may it for all that undergo a new *Fermentation* in our *Stomachs*: Which *Alterations*, I say, do prove a distinction of *Heat*, and a different power of dissolving *Bodies* to be in *Living Creatures*.

CHAP. VI.

The Virtue and Nature of Aliments remain in the Bodies that are Fed and Nourish'd by them.

I.
The whole
Aliment is
not chang-
ed into the
Substance
of the thing
nourished.

THO' *Aliment* or *Food* in *Living Bodies* be digested by the *Natural Heat*, and by that means becomes changed into their nature, yet it is not so entirely assimilated to them, as not to retain some of its former *Nature* and *Virtue*. This appears from our *Excrements*, which tho' by the heat of our *Stomachs* they have been separated from the thinner parts of our *meat*, and as it were changed into a quite different substance, yet retain something of the *virtues* and *qualities* of those *Bodies* whence they have been separated, and often preserve something of their colour and smell. Thus they who eat any quantity of *Black Cherries* or *Myrtle Berries*, will find their *Excrements* ting'd of a *Black Colour*. And *Sparagus* and *Turpentine* after having pass'd through the *Stomach* and other *Organs* of *Nutrition* communicate their *Odour* to the *Urine*.

II.
Some part
of the Ali-
ment is
kept or re-

If therefore so great *virtue* of the *Food* do still remain in the *Excrements*, with much more reason may we conclude, that the same much more abides in the *Bodies* that are nourish'd by, and receive

their encrease from them; forasmuch as the more pure and *Juicy* part of the *Food* abides with them, which doth most abound in *virtue*. And tho' *Animals* void many particles of their *Aliment* by *Siege*, by *Urine*, by *Sweat* and by *insensible Transpiration*; yet cannot this hinder us from concluding that many *Particles* of *Aliment* must remain in the *Bodies* of those *Animals* that are nourish'd and grow by it. Hence it is that *Country People* that feed upon *Beef*, *Bacon*, *Cheese*, and such like strong *Food*, which nourish much, but are somewhat hard of *Digestion*, are much more strong in *Body* than those who feed upon *Dainties*, who generally are weak and unfit to endure labour. Who doth not find in himself a different state of *Body* when he drinks *Wine*, than when his ordinary drink is *Beer*, *Ale* or *Water*? And do not those that that fare deliciously and feed high, find themselves more ungoverned in their *Passions* and *Lusts*, than those who live abstemiously, and content themselves with necessary *Food*?

The *virtue* of *Aliment* is more particularly discernible in the *fruits* and products of *Plants* and *Animals*, which differ, according to the diversity of the matter whereof they are formed. Thus *Milk* is not always qualified alike, but according as the matter of it is drawn from such or such *Plants*, its *virtues* and *qualities* vary. *Cows* that feed upon *Grass* yield a very different *Milk* and *Butter* from those that eat *Straw*. It is a matter also of common Experience, that *Cows* that in their feeding light upon *wild Garlick*, communicate a strong taste of *Garlick* to their *Milk*; and that the flesh of *Sheep*, which feed upon *wild Thyme* hath a much more grateful taste than that of others. *GALEN* makes mention of a certain *Medicinal Milk* which is very prevalent in the cure of the *Schirrus* or hard swelling of the *Liver*; the *Cow* that yields it being made to feed on some peculiar *Herbs* conducing to that end. The story also of that *Young Woman* is well known, who having used herself to the eating of *Wolfs-bane* (which is a most poisonous *Herb*) tho' she found no hurt by it herself, yet was the death of those men that lay with her.

Physicians likewise do observe, that if the *Milk* of a *Goat*, that hath fed upon some purging *Plant*, be eaten by a *Nurse* that suckles a *Child*, it will communicate its purging *virtue* to the *Nurses Milk*, and purge the *Child* that sucks it. It is known also that the *Milk* of *Cows*, and the *Butter* made of it is far better in the *Spring*, when *Cows* feed upon tender *Herbs* and *Flowers*, than at other times. So likewise it is observed that the *Honey* which the *Bees* gather from *Thyme*, *Sage*, *Savory* and *Tree Trefoile*, being the *Herbs* they most of all delight in is the best of all other. For this reason the *Honey* of *Sardinia* hath a bitter taste, because it is mostly gathered from *Wormwood*. And *Historians* tell us, that the *Honey* made about the City *Heraclea* in *Pontus*, had a venomous quality, because it was gathered from the poisonous *Aconite*.

The same may be also experienc'd in *Wine*, which being adulterated with *Quick Lime*, *Plaster of Paris*, *Rocket*, *Wild Myrtle* or *Butchers Broom*, *Jews Lime*, *Clary* and the like, becomes pernicious to the *Body* of *Man*. There are also some sorts of *Wine* which do particularly affect our *Dispositions*.

mainly with
the Body
that is fed.

III.
Milk is dif-
ferently
qualified
according
to the dif-
ference of
the Pasture
the Cows
graze in.

IV.
Herbs after
they are
turned to
Blood re-
tain their
purging
virtue.

V.
The Ground
or Soil in
which the
Vines grow,
communi-
cates to the
Wine some
of its vir-
tues.

tions. It is an Observation of LEMNIUS, that the Common People in Holland, by their much drinking of Poitou Wine, which sends sharp Fumes up to the Brain, are thereby inclined to be very peevish and quarrellous; whereas those of them that drink Rhenish Wine, are not so. And it is observed, that the Fruits and Plants which are the product of dung'd Grounds are not so good and wholsom, as those that grow, where no such Art hath been used: As likewise, that the Grain or Pulse that grows on such ground, cannot be so long kept from becoming musty, or being eaten by Worms; and that the Beer brewed of such Grain doth sooner turn Sower.

VI. Living Creatures retain the Qualities of their Aliment.
The Virtue of Food is also perceiv'd and distinguish'd in Animals. For in some parts of Holland, which is a Watry Country, and abounding with fish, they fatten their Hogs with them; which tho' they soon fat them, yet it is observed that the Flesh of these Swine is more flaggy and less firm, neither is it so wholsom; and differs much in Taste from the flesh of those Swine, which have been fed with more convenient Aliment: Because Fish, as GALEN observes, generates a thinner Blood, and more Excrementitious, than the flesh of Terrestrial Animals.

VII. Many Diseases arise from the Qualities of Food.
So likewise from the Qualities of Aliments, remaining in the Body of Man, many Diseases are generated; as the Scurvy, the Gout, &c. Thus we find that the Scurvy is an Epidemical Disease in those Countries, where they eat Meat much salted, and dried in the Smoak, and brew their Beer of Brackish Water. And those are commonly troubled with the Gout, who live intemperately and luxuriously, especially if they feed much upon salt Meats, and drink much Wine. For as the Learned Dr. WILLIS observes in his *Pathologia Morborum*, by this means a raw and indigested Chyle is prepared; and then, by the intemperate drinking of Wine, those Saline Dregs, which otherwise would go to the Excrement, and be carried forth with them, being too much exalted, are conveyed into the Blood: To which Enormities of Diet, if a Sedentary Life, Idleness, and Sleeping after Dinner do concur, whereby those Superfluities are hindered from exhaling, or being discurr'd by Labour and Exercise, they will the more certainly produce the Gout, and that in the worst manner.

CHAP. VII.

Living things do vary and alter, according to the difference of Place and Time.

I. What the Alteration or Change of Bodies imports.
A Body is said to be alter'd, when it suffers any change in the figures of its Sensible or Insensible parts; or when it loseth some Parts, and acquires others. Thus a bruised Apple is said to be changed or alter'd, because many of its parts have acquired another Position; and some of them may have quite changed their former figures. This Alteration is caus'd two several ways in Living Bodies, either by being removed from one place to another, as from a hot to a cold Country; or on the contrary; or by the different Seasons of the Year, which is the diversity of Time.

II. The Difference of
Living things, that are removed from one Country to another, are by this means variously

alter'd, being sometimes meliorated, and sometimes again degenerating, as the Climat doth agree, or disagree with them: And this, because of the difference of Heat and Cold, Moisture and Driness, that predominates in those Countries; for according as the Climat or Soil of any Country differs, so the disposition of those Bodies that are there differ also. Thus some Plants grow much taller and fairer in some Countries and Soils, than in others. Some Plants being removed to a better Air and Soil, are thereby meliorated and bring forth wholsom Fruits; whereas in their Native Soil, they brought forth deadly and poisonous Fruits. As COLUMELLA acquaints us with a certain Plant, which by being removed from Persia to Egypt, loseth its venomous Quality, and becomes wholsom to those that eat it.

III. Herbs vary according to the diversity of the Soil or Country where they grow.
Thus Herbs that grow in Barren Grounds, are very different from those that grow in a rich and fat Soil, which are far more large and fair, than the former. Thus Bugloss, Comfrey and Avena, change the colour of their Flowers by the Industry of Gardiners, and the Fruitfulness of the Soil where they are planted. Violets also, whose Natural colour is Purple, are changed into a Blew, when they grow in rich Ground. In like manner, some Plants that are armed with Thorns and Prickles, being transplanted to some certain places, lose much of their Prickliness.

IV. Plants degenerate, when transplanted from a fruitful Soil, to a barren.
And on the contrary, Plants removed from a fat and rich Ground, to a dry and Barren place, do frequently degenerate. So we find that the Plants brought from the Canary Islands, and other hot Countries, if they be planted in our Northern Climat, lose much of their genuine Virtue and excellence; as we see in the Herb called Masterwort, which tho' it retain the same outward shape and appearance, yet differs very much in force and virtue, from what it is in those hotter Countries. Yea, it is reported by some, that the Earth brought from the Fortunate Islands, and other far distant Countries, into Italy, hath brought forth several strange Plants, different from those that grow in Europe.

V. All Plants have particular places which they delight in.
All kinds of Plants affect some particular Climat and Soil, and especially those places where they sprung up at first, whence they cannot be removed without danger of being prejudiced thereby. For some love shady and moist places; others, high grounds, and expos'd to the Sun; some delight in morish and fenney Ground, others in dry and sandy; which, if they be removed from these places, lose much of their virtue and fairness. Those which delight in hot Countries, will not grow in those that lye far North; neither will those that thrive in cold Countries, live under the Torrid Zone. Thus Wormwood grows plentifully in Pontus; Orris, in Dalmatia; Hellebore, in the Island Anticyra; Sea Purslan, on the Sea-shoar. VIRGIL, in the Second Book of his *Georgicks*, does elegantly set this forth:

All Grounds not all things bear, the Alder-Tree Grows in the Fens; with Sallows Brooks agree:

Ash, craggy Mountains; Shoars sweet Myrtle fills;

And lastly, Bacchus loves the Sunny-Hills.

VI.
Those that
thrive in
Hot Coun-
tries, com-
monly dye
in Cold
Countries.

VII.
Change of
Place is
the Cause
of Altera-
tion in
Animals
also.

VIII.
Difference
of Time
and Sea-
son, is the
Cause also
of altera-
tion in
Living
Bodies.

For the Plants that thrive in *Arabia*, the *East* or *West Indies*, *Brazile*, &c. being transported to *France*, *Flanders*, or *Germany*, do not grow there without great Pains-taking, and after all do not answer the *Virtues* of those that grow in those hotter Countries. Yea, the curious lovers of Plants, when they transplant any *Herbs* or *Trees*, take diligent observation of their standing in the places where they Naturally grew, what part of them was turned towards the *Pole*, &c. that they may set it again in the very same manner as it stood before; because they suppose that the change of their former situation may very much hinder the thriving of them, and spoil the inward disposition of their Parts. See the *History of Nature*, concerning Plants, Chap. VI.

Much a like Alteration we shall also find in *Animals* that are transported from one place to another. For we find that *Youtbs*, upon any considerable changing of the *Air* wherein they were born, do shoot up strangely in a few Months time, more than they would have done, had they continued at home in several Years. Others again, upon changing of their *Native Soil*, do grow thin and meager, and lose their fresh and lively colour. It is also notorious, that some persons have an Antipathy against some places, because that where they were born is of a quite opposite Temperament.

Neither doth the Difference of Time occasion a less change in *Living things*, than that of Place. For tho' Plants be nourished all the Year through, yet do not they always shew forth the same effects of their Nourishment; for during *Winter* they are divested of their *Leaves* and *Seeds*, excepting only some few, viz. the *Bay-tree*, the *Yew*, the *Ivy-bush*, &c. which by reason of the clammy Juice where-with they are nourished, do not shed their *Leaves*, as the rest do. Accordingly also Care is taken, that such *Seeds* which can endure the *Frosts* of *Winter*, be sown in *Autumn*; and others again at the beginning of *Spring*, or a little before the *Humour* begins to move, lest by the too abundant affluence of it, the *Roots* should perish. For as some *Seeds* are spoiled for want of *Moisture*, so others perish by an overplus of it. *Fruits* also are subject to *Alteration*, according to the several Seasons of the Year, most of which are only green in *Summer*, but attain perfect maturity in *Autumn*, and losing their former taste, smell, and colour, do acquire new *Qualities*, and accordingly affect our Senses.

CHAP. VIII.

Of Plants; and first of all of their several Parts.

I.
The Parts
of Plants
are either
Simple or
Compound.

HAVING hitherto spoke of *Living Bodies* in *General*, we come now to the handling of *Plants* in *Particular*, to the end that having explained their *Nature*, what we have to say concerning *Animals* may be the more readily understood. The first thing to be considered in *Plants*, is their *Parts*, which are either *Simple* or *Compound*. I call those *Simple parts*, which consist of *Particles* of the same Texture and Constitution; such as are the *Juices* or *Liquors* contained in them. The *Compound parts* are those that are made up of parts

of a different Nature; and are also called *Organical parts*, because they concur to some one *Action* or other; as the *Root*, *Stalk*, *Leaves*, *Flowers*, &c. Some whereof are *Perficient* and *Integral*; others *Conservative* of the kind; others *Ornamental*, and others *Defensive*. The *Parts* belonging to the compleating and perfecting of a *Plant*, are the *Root*, and *Stem* or *Stalk*; those that concur to the propagating of their kind, are the *Fruit* and *Seed*; and those that defend them from the Injuries of the weather, and otherwise, are the *Bark* Those or *Prickles*, *Shells*.

The *Simple* or *Similar parts* are the *Juice*, or *Moisture*, the *Nerves*, the *Windpipe*, and the *Flesh* of *Plants*.

The *Juice* or *Moisture*, is the liquid part of a *Plant*, diffused through the substance of it. This *Juice* is, as it were, the *Blood* of the *Plant*, which if it chance to burst through any part of it, whether of its own accord, or by the heat of the *Sun*, or by cutting or lopping of the *Plant*, is called a *Tear*, because it breaks out of the *Tree* like a *Tear*, or *Drop*. Which *Drops* are twofold: The first are such as are of a *Watry Nature*, having something of an *Earthy* consistence joyn'd with them, and are called *Gum*; which is that congealed and thick *Liquor*, that proceeds from the *Trunks* of *Trees*, and cleaves to the *Barks* of them; and the other more oily and fat, which is called *Rosin*.

Nerves in a *Plant*, are those *fibres* or *strings*, which give consistence and strength to the softer *Parts* of a *Plant*; and by which the *Alimentary Juice* ascends. The *Spirit* contracts the *fibre* or *string*, and so drives the *Moisture* upwards, which descends through the little *Bougets* or *Membranous passages*. For in every *Plant*, besides the *Sensible Body*, there is a *Subtil vigorous Body*, the *Producer of Motion*, viz. the *Spirit*, which runs through the whole *Body* of it.

The *Trachea* or *Wind-pipe* of a *Plant*, being also a *Similar part*, is an open and wide *Vessel*, consisting of little thin *Plates*, ranged like the *Scales* of a *Fish*, or writhen and twisted together, being for the most part of a *Silver colour*; and may be easily stretched, prest and bent. In the *Trunk* or *Stem* of a *Tree* they run upwards; in the *Leaves* they are made like a *Net*, and take up great Spaces in them; in the *Sprouts*, *Buds*, and *Shoots* they are twisted, and are called by a Learned Man, *Vasa spiralia*, *Spiral Vessels*.

The *Flesh* is another *Similar part* of a *Plant*, which is thick, but somewhat soft, and is outwardly cover'd with the *Bark*: Of which hereafter.

The *Compound*, or *Dissimilar parts* of a *Plant* chiefly, are the *Root*, the *Stem* or *Stalk*, the *Bark*, the *Pith*, the *Branches*, *Leaves*, *Flowers*, and *Fruits*.

The *Root* is the lowest part of a *Plant*, sticking in the ground, through the passages and pores whereof the *Alimentary Juice*, being moved by *Heat*, is driven upwards. This *Part* is so necessary to *Plants*, that none can subsist without it. There is one kind of the *Herb* called *Chamæleon*, which wants a *Stalk*; *Wheat* hath never a *branch*; the *Fig-tree* hath no *flowers*, *Jesamin* hath no *fruit*; but there is no *Plant* without a *Root*, nay, there are some that are nothing else but a *Root*, viz.

II.
The Simple
parts of a
Plant.

III.
Juice or
Moisture.

IV.
The Nerves
or Sinews.

V.
The Wind-
Pipe.

VI.
The Flesh.

VII.
The Com-
pound
Parts.

VIII.
What the
Root is.

viz. a *Mushrom*. For the *Root* is, as it were, the *Mouth* by which the *nourishment* is taken in, or like the *Hand* by which *Plants* draw *Juice* out of the *Earth*, and send it up into the *Trunk* or *Stem*. And to this end it is *porous*, and full of many loose *passages* for the humour freely to ascend that nourisheth the *Plant*. The *Roots* are very different in their *Figures*, so that almost every different kind hath *Roots* of a different figure: In a *Fig Tree* and *Olive Tree* the *Root* is single, and sinks very deep, yet sends forth several little *twigs* from the sides of it. In *Leeks* and *Onions* the *Roots* are manifold, as consisting of innumerable *threads* or *Hairs*; in *Turneps* it is *Round*; in *Beets* it is without *Joints*; in *Orris* it is full of *Joints*; sometimes it consists of many round *knots*, as in *Birthwort*. Yet all *Roots* generally agree in this, that they end in a *Cone*, or sharp point; for the upper part of the *Root*, drawing to it self more *Aliment*, doth grow to a greater bulk than the lower part.

IX. The *Stock*, *Trunk* or *Stalk* is that part of a *Plant*, which riseth up from the *Root* above the *Earth*, and transmits the *Moisture* it receives from it to the utmost parts of it. In *Herbs* it is properly called the *Stalk*; when it is hollow, it is called *Calamus* the *Reed*, and in *Corn Culmus*, the *Blade* or *Straw*, and in *Pulse Scapus*, the *Shaft*. The *Stock* or *Stem* of a *Plant*, before it be turned into *wood*, consists of a *spongy substance*, somewhat soft, and full of a coagulated *Juice*, from the abundance whereof its *Green Colour* proceedeth. If the top of it chance to fall off, it grows so much the thicker, because then it enjoys that part of the *Aliment* which was appointed for the *nourishment* of the top, and thereupon dilates its self and grows bigger in bulk. It is common to the *Trunks* of *Plants* to become *crooked*, and to bend one way, when the *ground* begins to be dry and *sapless*, and furnisheth a more hard *Alimental Matter*, than can be well digested by the *Tree*. Tho' the *Stocks* of *Plants* be generally *Cylindrical*, yet there are some that are *corner'd*: In *Daffodils* the *Stalk* is two-corner'd; in *Cyperus*, which is a kind of *Rush*, it is three-corner'd; and in *Horehound* the *Stalk* is 4 square.

X. The *Bark* is, as it were, the *Skin* or *Hide* wherewith the *Plant* is cover'd; and the same is manifold in one and the same *Plant*, *viz.* the outward, which resembles the *Cuticle* or thin outward *Skin* in *Man*; the middlemost which is thicker like a *Hide*; and the inmost which is like a thin *Membran*. And therefore the *Bark* is reckon'd amongst the *Dissimilar Parts* of a *Plant*, because it consists of a great variety of *Strings* and *Fibres*, and of several *Coats*. For it is not the same in all *Plants*; for in some it is thick, as in the *Poplar Tree*; in others thin, as in the *Bay Tree*; in a *Reed* it is like a *Membrane*; in a *Vine Nervous* or *Sinewy*. In the *Spring* time the *Bark* is with ease separated from the *Tree*, because of the *Juice* that ascends between it and the *Tree*, which dissolves that *Glew* whereby it was before fastned to the *wood* of it.

XI. The *Pith* of a *Plant*, which by way of excellence is called the *Heart*, *Brain* and *Matrix*, is that middle part whereby the *Aliment* is conveyed from the *Root* to the upper parts. The same is also very different; for in some *Plants* it is soft and spongy, as in the *Elder Tree*, where it

resembles *froth*; in others again it is harder, as in the *Pine Tree*, whose *Pith* is *woody*. The *seminal virtuz* of the *Plant* is suppos'd to be lodg'd in the *Pith*, forasmuch as not only the *Branches*, but the *Fruit* and *Seed* are derived from it.

The *Branches* are the upper parts of a *Plant* which spread themselves from the *Stalk* or the *Trunk* of a *Tree*, as so many *Arms* stretched forth, to which they are joined by a *glutinous substance* hardened, which they call *Nodus* or a *Knot*, and in their sprouting forth from the *Trunk* make an *Angle*, which in Latin is called *Sinus*, resembling the *Arm-pit*, or the joining of the *Arm* to the *Body*. In many *Trees* the *Branches* grow without any order, but in the *Pitch* and *Fir Tree* they appear in a curious and beautiful ranging; the thinner and utmost parts of the *Branches* are called *Sprigs*, which are more tender than the rest of the *Branch*, having not long been expos'd to the intemperature of the *Air* or *Weather*. The swellings that appear in the *Joints* of them, are called *Buds*, as long as they continue round, and are not yet open'd. And the thin tops of the *Sprigs* are called *Sprouts*.

Leaves are the ornament of *Plants*, and the coverings of the *Flowers* and *Fruit*, shading them from the *Heat*, and defending them from the distemperature of the *Weather* or *Air*. They generally proceed from the more thin and tender part of the *Bark*: so that when the *Bark* is pluck'd from a *Bough*, we find that the *Leaves* stick to it, and are pull'd off together with it. Yea, if the whole hollow of the *Bark* be pull'd off from a *Branch*, and the lower part of it be put into *water*, in the *Spring* time, *Leaves* will sprout forth from the upper part of it. The *Figure* of *Leaves* is manifold; for in some *Plants* they are large and broad, as in a *Gourd*; in others very small, as in a *Pine Tree*; in some thick and fleshy, as in *Purslain*; in others nervous and full of *Sinews*, as in *Wheat*; in *Onions* they are hollow like a *Pipe*; in *Aloes* partly round, and partly angulous. The *Stalk* or *Stele* of *Leaves* is also various; in those of an *Olive Tree* it is short; that of *Vine Leaves* is somewhat long; in *Colts-foot* and *Herbs* that grow in *Ponds*, the *Stele* of the *Leaves* is very long, because in them it is instead of a *Stem* or *Stalk*. Sometimes only one *Leaf* grows upon one *Stele*, as in the *Poplar* and most other *Trees*, sometimes more, whence those *Plants* are called 3 leav'd, 5 leav'd, 7 leav'd.

Flowers which are the most beautiful product of sporting Nature, do greatly conduce to the Ornament of a *Plant*. They consist of a four-fold substance, or rather of so many parts, *viz.* of the *Knot* or *Cup*, the *Leaves*, the *Threads* or *Thongs*, and the *Stalk* or *Stele*.

The *Knot* or *Cup* is that part which covers the *Flower* and keeps the parts of it together; as being the *Base* and support of it; and therefore is of thicker and stronger substance, and not so beautiful as the *Flower* it self.

The *Leaves* of the *Flower* compose the *Body*, and Beauty of the *Flower* it self, being remarkable for their *Tincture*, but very fading, and of a very tender Complexion and Texture.

The *Threads* are those long and slender parts in the middle or *Navel* of a *Flower* like *Hairs* or *Threads*, which in some *Flowers* are thicker than

XII.
The Branches.

XIII.
The Leaves.

XIV.
The Flowers.

in others, and often have little Spires at the top of them; and are set round about the *Stele*, which is a long, but thicker part of a *Flower*, rising up from the middle of the *Navel* of it.

The *Stele* is the middlemost part of the *Flower*, sticking to the Rudiment of the *Fruit* or *Seed*. It is called in Latin *Stylus*, because of its being thin and long. All these parts are very distinguishable in a *Rose* and *Lilly*.

XV.
The Diversity of Flowers.

Some *Flowers* want a *Stele*, as those that grow upon the *Bay Tree*; some instead thereof have a *Stalk*, as *Saffron*. All others generally have a *Stele*, as appears in the *Apple Tree* and in a *Rose*. But more particularly they differ in colour, which in a *Violet*, is Purple; in a *Marygold*, Yellow; in a *Blue-Bottle*, Blue; in a *Lilly*, White, and in a *Rose* various, there being *Red Roses*, *Damask Roses*, *White Roses* and party colour'd. Neither do *Flowers* less differ by their *smell*: And what is worth our consideration, we find a most grateful odor in a *Rose*, and none at all in the *Plant* whence it grows; whereas in *Sage*, the *Flower* is without any *smell*, tho' the *Herb* it self be very odorous: In *Borage* we perceive both *Plant* and *Flower* destitute of any *scent*; whereas in *Lavender* both the one and the other are odoriferous.

XVI.
The Fruit.

The *Fruit* as it includes the *Seed*, and *Flesh* or *Pulp* of the *Fruit*, is the last work, and, as it were, the Masterpiece of the *Plant*; and to the producing whereof all the other parts of the *Plant* do concur. Its *Fashion* or *Figure* is various; some are partly of a *Conical* figure, as *Pears*; others of a solid *Elliptick* figure, as *Olives*, *Plums*, &c. some are *Round*, but somewhat flattened at both ends, as *Apples*; some perfectly *Round*, as *Cherries*, *Grapes*, *Berries*, *Correns*. They have also different Coverings; for *Wheat* is cover'd with a single *Membran*; a *Chestnut* with a thick *Skin* full of *Prickles*; an *Acorn* with a scaly *Shell* or *Cup*; *Almonds* and *Walnuts* inwardly with a hard *Shell*, and outwardly with a green *Shell* or covering.

XVII.
How Plants are said to bring forth their Fruits.

Plants are said to bring forth, when they bloom or flourish, and when the *Flowers* break forth from the *Knops* or *Buds*; but the Education or Rearing of their Offspring is in the *Fruit*, for the sake whereof a *Plant* grows, and is therefore call'd the *Mother* and *Nurse* of her *Fruits*.

XVIII.
Whether Leaves, Fruits and Flowers be the true Parts of a Plant.

It hath been a long controverted Question amongst the *Ancients*, whether *Leaves*, *Flowers*, and *Fruits*, were to be accounted parts of a *Plant*. THEOPHRASTUS seems inclin'd to the negative, as supposing them to be no more the parts of a *Plant* than the *Births* of *Animals* are any part of them; for they being after a certain term separated from their *Parents*, cannot after that properly be called *Parts* of them. But this Controversie seems only to be about words: for if *Leaves* may not be accounted as the *Parts* of those *Trees*, whence they are yearly separated at the *Fall*, as in the *Oak*, *Walnut-tree*, &c. why may not they as well be denied to the *Pine*, *Olive Tree* and such others which never are without *Leaves*, seeing that those *Trees* also lose their *Leaves*, tho' not altogether, but by a continual succession of new ones, shooting out in the room of the old ones. Therefore those who account only that to be a part of a *Plant* which always continues with it, have good

reason to bar *Leaves* of that Privilege; for otherwise I see no reason, but they may well enough be admitted to be parts of a *Plant*.

CHAP. IX.

Of the Original of Plants.

IT cannot be questioned, but that in the Beginning of the World there was a Power communicated to the *Earth* of producing *Plants*, and that great variety of *Vegetables* that are found in all *Countries*. In the first Chapter of *Genesis* we find these words, Let the *Earth* bring forth Grass, the *Herb* yielding *Seed*, and the *Fruit-Tree* yielding *Fruit* after its kind, whose *Seed* is in it self after his kind. Now this virtue imparted to the *Earth* continues still in its full vigor, neither doth any thing spring out of the *Earth*, but by this virtue. But forasmuch as many *Vegetables* seem to spring of themselves, whereas others are manifestly beholden to *Root* or *Seed*, for their Growth or Production; we are to enquire how this twofold Production is performed, and how it comes to pass that some spring as of themselves, whereas others stand in need of a manifest *Seed* for their Production.

Those *Plants* are said to spring of themselves, which the *Earth* produceth without the sowing of *Seed*, and to grow by accident, as the *Schools* express it. Such as are *Purslain*, *Housleek*, *Penny-royal*, &c. which, as some tell us, do of themselves grow out of the *Earth* that is dug up, in a shady and moist Wood, being put into *Earthen Pots*. PORTA tells us, lib. 2. Phyt. cap. 1. that having exposed some *Earth* that had been dug up from the deepest foundations of a *House*, to the *Air*, within a few days, several kinds of *Herbs* sprung up from it, familiar to the *Soil* and *Climat* of *Naples*. And the famous Lord VERULAM assures us, that the *Earth* dug up from the foundations of *Houses*, or from the bottom of *Wells*, being put into *Pots*, will after a set season produce several sorts of *Herbs*. For if you take up *Earth* not above an Ell deep, it will be fruitful the first year; but if you take up that which lies deeper, it will not produce any thing till after a years time, and sometimes 2 years.

Some *Philosophers* are of opinion, that such *Plants* as these are produced without any *Seeds* at all, and that the *Earth* produceth them by an innate virtue of their own. But that which hinders me from assenting to this opinion is, because I find that all *Countries* do not produce the same *Plants*; which could not so happen if there were not diverse dispositions in them, proper for their several Productions. But what can these different Dispositions be, but *Seeds*; or those first *Buds* from whence *Plants* arise? For what else doth the *Sun* do, when it cherisheth the *Earth* with its heat, mixeth it with *Water*, exhales the moisture from it, dries the *Particles* of it, &c. but work such dispositions in the *Earth*, and so fit the insensible parts of it, as that from the due ranging of them, the *Roots* of *Plants*, their *Strings*, *Ribs* and *Veins* are formed, through which their *Aliment* may be conveyed, and being sufficiently prepared, break forth in the other parts of it?

The

I.
There is Virtue in the Earth, whereby it is empowered to bring forth Plants.

II.
What those Plants are that grow of themselves.

III.
The Plants which are said to grow of themselves, owe their Rise to Seeds.

IV. What are the Seeds of Plants, that are said to grow of themselves.

The Seeds therefore of these Plants, are those *Insensible Particles*, which by the agitation of the *Subtil matter* do obtain such a *situation, figure, and motion*, as are needful to form the first Rudiment of a Plant. And forasmuch as this *disposition of parts* is not to be found in all Parts of the Earth alike; therefore it is no wonder, that all Plants grow not in all Countries. We are to take Notice also, that there is no difference betwixt these kind of Seeds, and those which are the Product of Plants; save only this, that the Parts of these latter are more closely compacted together, and more orderly framed: Whereas those which arise from the various *Motion, Spreading, Mixture, and Composition* of concurring Particles, are not so exactly joyn'd and formed, and therefore Plants are more slowly produc'd by them.

V. The first Trees were produc'd without Seeds.

Some Authors relate as Miracles, that sometimes tall Trees, yea, whole Woods, have sprung out of the Earth, without Seeds: But they did not consider, that vast store of Seeds, which are hid in the Earth, and are the beginnings and first Draughts of those Seeds that are the products of Herbs and Trees. THEOPHRASTUS observes, 3. *Histor. 2.* that the Earth in Crete, presently after it was dig'd up, did bring forth Cypress Trees, which are also propagated by Slips. Can any one believe, that the first Trees were the product of Seeds fallen from Trees? Or, that the Great Woods that are found up and down, were sown by Men? For seeing that the World had a Beginning, and that we cannot admit a progress to Infinite, we must come at last to those Trees which had no such Seeds, whence they were produc'd, and for the production whereof the Nature of the Climat and Soil were sufficient. For Cinnamon, Myrrh, Frankinsence, and Cassia, did always abound in Southern Countries; as the Northern Grounds never wanted Willows, Oaks, Fir-trees, Elms, &c. which delight most in those places, and will not without care and difficulty grow elsewhere. According to that of Virgil:

The blackest Ebony from India comes,
And from Sabæa Aromatick Gums.

VI. Calcined Earth produceth great abundance of Plants.

* Some observe, that Earth that is burnt or calcined, when expos'd to the Air and water'd with plentiful Showers, doth immediately bring forth great store of Vegetables; because the Pores of the Earth being opened by this means, the Seeds are set free from their Prisons, and meeting together are entangled, and so constitute little Masses, from whence those Plants proceed. It is a thing very notorious, that in Walks that are thick overspread with Sand, the Earth the first Year produceth only knotted Grass, and the following Years a thick and swollen Grass, like the blade of Corn; because the hardness of the Sand or Gravel hath hindered the due coagulation of the Seeds; but as the surface of the Earth comes to be more freed from the Sand, the Seeds can the better come together, and thus produce common Grass, to which Showers do very much contribute, by moistning the Earth, and thereby setting the Seeds that are in it more at liberty.

VII. How Plants are produc'd from

As to Plants that are Sown by Men, the Explication of their way of Production is not difficult. For when, by Example, a Pea or Bean is put into

the Earth, and there meets with a due moisture and moderate heat, it first begins to swell, and distends its Skin or Husk, and having at last broke it, the same Causes continuing, do afford it new Matter; and the first beginning of the Plant, which we call the Bud, appears; which by thin Fibres or Strings, spreading it self through the pores of the Earth, and the Parts of it pressing upon it, must needs grow hard; and thus is the Root of the Plant formed. The Matter being thus digested into a Root, being recruited by new Incomes of Heat, and dilated by the same mounting upwards, the tender and green Substance, which is commonly call'd the Leaf or Bud, riseth and springs up; which still growing higher, turns to a Stalk: For a purer Juice being now duly prepared in the Roots, doth by degrees ascend from thence into the Stalk, which Motion upwards is much promoted by the pores of the woody Stalk or Stem. Moreover, Heat being active and impatient of Idleness, continually drives the moisture or Juice upwards; and so the Stalk becomes extended, and riseth to a considerable height. Now when the Juice doth not ascend so fast, and that the parts of it, by the agitation of Heat are more depurated, they are by the driving of the Fire carried above the Stalk, where meeting with the cold Air, they are stopt from mounting any higher; where still more particles of the said Juice joyning them, they swell into a Bud. And whereas the affluence of Heat through the Stalk still continues, is bursts open, or splits the Bud, and by this means makes way for the Subtil matter to break forth, and display it self in the appearance of a beautiful Flower. And lastly, after that the Alimentary Juice hath still attained a further degree of Perfection, another Substance succeeds in the room of the Flower, which being hollow within, contains the Fruit, that is, the Pea or Bean, and is a defence to it, against the Injuries of the Air. For in all Natural things there is, as it were a kind of Circle, whilst the Seed of the Plant, under a different respect, is called the Antecedent Principle; and the Fruit the Consequent.

perfect form'd Seeds.

CHAP. X.

Of the Nourishment, and Growth or Increase of Plants.

HAVING spoken of the Forming of Plants, we now proceed to Treat of their Nourishment, which seems to be nothing else but a continued Generation; because all the Parts of that which is generated would fall away immediately and waste, without the supply of food, that preserves them from perishing.

The Nutrition of a Plant therefore is the distribution of the inwardly received, and altered Aliment, into all the Parts of it; and the transmutation of it into their Substance, for the supply of what continually wastes and evaporates by the force of Heat. For the Moist parts of Plants, as well as Animals, are in a continual flowing, as is manifest from the Leaves and Flowers that are pluck'd off from them; for these immediately grow limber and wither, by the want of that Juice, which used to distend their Vessels and Bladders.

I. The Generation of Plants, is accompanied with their Nutrition or Nourishment.
II. What the Nutrition or Nourishment of Plants is.

III.
Nutrition
in Plants,
is not an
effect of
Choice.

Not that *Plants* make use of choice in attracting of their *Aliment*, so as to take in that which is agreeable to them, and reject the contrary; forasmuch as no such *attraction* can be found in *Natural things*: But we must rather conclude, that the *pores* of the *Roots* are of such a figure, as are fit to admit those *particles* that are proper to nourish the *Plant*, and exclude the rest; after the same manner as the *Liver*, by transmitting the *Gall*, and the *Kidneys* the *Urine*, do thereby separate them from the *Blood*.

IV.
Heat is
necessary
to the Nu-
trition of
Plants.

This will be still more manifest, if we suppose 2 things in *Plants*, viz. *Heat* and *Pores*, which are the *Instruments* of *Nutrition*: For by *Heat* the *Alimentary Juice* is driven upwards, not only from the *Earth* into the *Root*, but also into the *Trunk*, *Branches*, and the utmost *Leaves*: And in this its passage the *Nourishment* is further concocted, prepared, distributed and coagulated, so as to be fit for the *Aliment* of *Plants*. For in every *Plant* or *Vegetable* there is something, which with respect to the *Earth* whence they grow, has the Nature of a ferment.

V.
Whence
this Heat
proceeds.

If you demand, whence this *Heat* proceeds; and what that Agent is which begets a fire in *Plants*? I answer, That the *primary Cause* of this *Heat* is the *Sun*, whose *Rays* in the *Summer* time do continually beat upon the *Earth*, and the *Plants* that grow out of it: Neither is the *Earth* in the *Night*, or during the *Winter*, altogether destitute of *Heat*, but preserves always some portion of warmth communicated to her by the *Sun*, whereby she fosters the *Plants* in her *Bowels*, and assists their *Nutrition*. Tho' it cannot be deny'd, but that sometimes this heat in *Plants* is owing to *Subterraneous*, or any other fires: As we find that *Aloes*, *Onions*, the *Roots* of *Saffron* and *Leeks* will grow, being hung up in *Rooms*, especially where constant fires are kept.

VI.
Pores also
are neces-
sary to the
Nutrition
of Vegeta-
bles.

Pores likewise are of great use to the *Nutrition* and *Increase* of *Plants*, since they are the passages by which the *Juice* is received, and through which it is distributed to all the Parts of the *Plant*. For as the *Lacteal Veins*, and the *Subclavial Branches* of the *Vena Cava*, are necessary for the receiving of the *Aliment*, and the conveying of it from one part of the *Body* to another; so likewise there are found in *Plants* innumerable *Passages* and *Channels*; like to the *Lacteal Veins* in *Animals*, by which the *Juice* is transmitted from the *Root*, to the utmost parts. For such is the disposition of *Pores* in *Vegetables*, that the *Aliment* is much more conveniently transmitted by them, than it could be through the free and open *Air*; for by this means the dissipation of the *Alimental Juice* is prevented, and its motion is more ready and without interruption: As we find that *Bullets* move more readily through *Pipes*, and *Smoke* through the *Funnel* of a *Chimney*, than in the open *Air*. And hence it proceeds, that *Lands* that have been often sown, are thereby more exhausted, than those that lye fallow.

VII.
How Plants
are nour-
ished.

These things being understood, it will be no longer difficult to conceive, how the *Nutrition* of *Plants* is performed, and how they are increased; for *Vegetables* are nourished whilst the *Juice* is by the *Sun*, and the rest of the *Subtil matter*, driven into the *pores* of the *Root*, and being there prepared by Concoction, after it hath past several

strainings, doth spread it self in length, breadth, and depth. The softness also or tenderness of the *Sprout* or *Sprig*, doth much further the conveyance of the *Nourishment*; because it makes the *Pores* to be easily widened and distended. For as we find that the *pores* of *Bread*, being dipt in *Wine* or *Water*, become immediately distended thereby; so likewise the *Alimentary Juice*, when driven into the little *Channels* of *Vegetables*, doth open and extend them: Which doth not happen so in a dead or wither'd *Plant*; because in it the parts of the *Pores*, and small threads or fibres, are otherwise disposed, so as not to be able to admit the *Juice*, which the *Subtil matter* hath driven into the *Roots*.

The *Aliment* of *Plants* must be *Liquid*, because it would not be fit to be carried upwards, or strained, in case it were dry or hard. Yet is not this *Juice* a moisture destitute of all Clammy-fatness of the *Earth*: For seeing that the parts of a *Plant* must stick and grow together, and that this cannot be without the entanglement of *Heterogeneous particles*; it is evident, that *Water* alone cannot be a fit *Aliment* for *Plants*, except it be well temper'd, with a sufficient proportion of the Slimy-fatness of the *Earth*. And accordingly we find, that *Waters* in which *Salt* is dissolved, or mingled with some Fat matter, are most proper for this effect, and make the *Vegetables* that are watered therewith, to thrive mainly. And it is for the same Reason, that *Countrymen* do recruit their barren *Grounds* with *Dung*, *Marle*, and the like. For *Water* alone too swiftly penetrates the Parts of *Vegetables*, nor stays long enough with them, so as to become their *Aliment*.

Tho' the *Aliment* of all *Plants* be Moisture, temper'd with the Fatness of the *Earth*; yet is not every such mixture fit Nourishment for every *Plant*. For as *Vegetables* affect particular places; some delighting in shady and low *Valleys*, others in high and upland *Grounds*; some in dry and sandy, and others in moist *Ground*; some in a fat and rich *Soil*, and others in a barren and hungry: So accordingly do they stand in need of a different *Nourishment*, which when ever they miss of, they soon languish. For the *Particles* of these *Juices* being various, they must needs constitute different *Liquors*, whereof those only are a fit *Nourishment* for such and such a *Plant*, which have an affinity with it, by the suitableness of the configuration of their Parts. Thus it is observed, that those *Roses* smell sweeter, that have *Garlick* growing near them; because the *particles* proper to produce a strong and ungrateful Scent, are taken in by the *Garlick*: So that few or none of them can come to the *Rose*, to allay or diminish the sweetness of its Odour.

The *stocks* or *stems* of *Trees* and *Shrubs*, with the *Branches* proceeding from them, are every year increased by new woody accessions; forasmuch as every year, a new round of *Fibres* is added to the inward *Bark* or *Rind*; which being divided in two parts, the outward part of it is added to the *Bark*, and the Inward part growing harder and harder, before the end of *Autumn*, acquires the compactness of wood, and separating it self from the *Bark*, becomes joyned to the *Wood*, and so increaseth the *Trunk* or *Stock* of the *Tree*. But tho' we find, that the *Trunks* and *Branches* of *Trees* are

VIII.
The Nourishment
of Plants
consists of a
Moisture,
mingled
with the
Fatness of
the Earth.

IX.
Different
Plants re-
quire differ-
ent Nourishment.

X.
The Stocks
and
Branches
of Trees
grow every
year.

are encreased this way only, yet must we not conclude from hence, as is commonly believed, that the *Juice* or *Sap* of a *Tree*, mounts upwards only betwixt the *Bark* and the *Wood*, but also through those *Vessels* that lie hid in the *Substance* of the *Wood*. This is evident in that the deeper any hole is bored into the *Trunk*, the *Branch* or *Root* of the *Tree*, the more *Juice* will distill from it, and that proportionably to the depth of the hole; so that out of a hole that is twice as deep as another, almost a double quantity of *Sap* will proceed in the same time.

XI. This is illustrated by the Example of a young *Chestnut-tree*; for if the Progress of its growth be narrowly observed, we shall find, that after 6 months time, there will be formed in its *Bark* (which is very thick) 2 rows of *woody Fibres*; and after 18 months, we shall find 4 of them; and a year after 8, and so on, so that always the last *Rows* do inclose and involve the former, and make, as it were, a *Circle* about them, which is surrounded with another *Circle*, and that again with another; whence it follows, that when the *Stem* of any *Plant* is cut across, the Section must appear composed of 2 sorts of *Substances*, viz. of these *Circles*, and of *insertions* that are disposed or ranged in the said *Stock*, much like *Circles* of *Longitude* and *Latitude* in a *Terrestrial Globe*.

XII. How Plants grow and encrease. *PLANTS* therefore grow or encrease, when greater or more *Particles* of *Alimentary Juice* are received by them, than their narrow *Pores* are able to contain. Hence it is that those *Vegetables*, the sides of whose *Pores* are more hard and compact, do not grow so fast as others, whose texture is more loose and open. Thus we find that *Peach-trees*, *Poplars* and *Willows* grow apace, because they have pliable pores, and so crooked and bending, that the *Particles* of *Juice* that are driven upwards by the agitation of the *subtil matter*, can neither advance forward, nor return, and consequently they must enlarge and distend the *Plant*. And for this reason it is that a *Vine*, frequently watered, thrives and advances so fast; and that the *Chrysanthemum* or *Marygold* of *Peru* in 6 months time grows 18 or 20 foot high; and by the thickness of its *Branches* seems to challenge the tallest *Trees*. But on the contrary, *Oaks*, *Medlars*, *Box*, and *Pine-trees* grow very slowly, because the compactness of their *Substance*, will not suffer their pores to admit sufficient store of *Aliment* for their speedy growth and encrease. Thus *Golden Maiden-Hair*, *Whitlow-Grass*, &c. grow very slow: and for the same reason *Trees* advance little or nothing in their growth during the *Winter Season*, because their pores being then shut up by cold, the agitation of *heat* is not of strength enough to widen them, and to send up the *Juice* from the *Root* through them.

XIII. How the Juice comes to be joined to the Plants, and stay with them in order to their encrease. It may be questioned here, how the *Alimentary Juice*, which is forceably driven into the *Pores* of a *Plant*, comes to stay there, without being carried upwards into the *Air*, or without falling down to the *Root* again.

To which I Answer, that this effect may be assign'd to 2 Causes: the First is a special conformation of the *Pores* of *Plants*; for we may suppose that by the continual ascent and percolation of the *Alimental Juice* through the pores of

the *Plant*, many of their small *Fibres* must be bent in such a manner, as to make the passage rough, by which means, tho' the liquid and fat *moisture* easily mounts up through them, yet cannot so easily run back again, because of the prominent extremities of the *Branchy particles*, which oppose their return the same way they entred. Daily experience confirms this, for we find that when with a *Knife* we cut or scrape a piece of *wood* with the grain, that is following the natural position of its *fibres*, we do it with much more ease, than when we attempt the same the contrary way. The other cause is the *Winter Frosts*, and the coldness of the night, which do fix and condense the *Juice* conveyed to all the parts of the *Plant*, and by obstructing the *Pores*, hinder it from subliming into the *Air*. For it is certain, that in the *Nutrition* of *Plants*, *Heat* and *Cold* both act their parts, the one being not sufficient to perform it without the other.

It is to be observed, that as the *Blood* in *Animals*, so likewise the *nourishing juice* in *Plants* is prepared by a kind of *Circulation*. For the *Juice* that is in their *Roots* or other parts, being tost by a continual motion, cannot thoroughly be dissolved, mingled or strained, without frequently returning to the same part again, and being altered by various impressions. Which *Circulation* of the *Alimental Juice*, depends on the *Mechanical Structure* of the *Fibres*, the various disposition whereof performs the same effect, which the *Valvula* do in the *Veins* of *Animals*; some of them being so formed, that the *Juice* finds a ready way to mount up between them; and others, so as to afford it an open and free Descent. Which may be proved by several Reasons and Experiments in those *Vegetables*, which are nourished by a thick *Juice* resembling *Milk*.

Mr. MARIOTTE assures us that he hath observed, that upon the cutting off the *Tops* of *Milky Plants*, and the parts nearer the *Leaves*, a greater quantity of *Juice* hath proceeded from them, than by cutting the parts nearer to the *Root*. That he experienced this in *Celandine*; and the structure of *Fibres* in *Spurge*, and other *Milky Plants* persuades the same; for these *Fibres* by the help of a *Microscope* appear white, and are nearer unto the *Kind*, whereas the *Juice* in the other *Fibres* is of a more *Warry Colour*. Whence it seems probable, that the serous *Juice*, doth mingle with the other thicker, whether *Yellow* or *White*, in certain *Pipes* appointed for that use, much after the same manner as the *Chyle* entering into the *Veins* is there mixt with the *Blood*, and circulates with it. Tho' it be not yet discovered whether this *Juice* in *Plants* be carried in the same *Pipes* from the *Branches* to the *Roots*, and again from the *Roots* to the *Branches*; or whether distinct *Pipes* are assigned to these different motions, as the *Veins* and *Arteries* in *Animals*.

CHAP. XI.

Of the Division and Difference of Plants.

A Perfect *Plant* is by *BOTANISTS* commonly divided into a *Tree*, a *Shrub*, and an *Undershrub*, and an *Herb*.

A Tree

XV. The *Alimental Juice* in *Plants* is circularly moved.

XVI. The Proof of this Circulation in *Plants*, from those of them that have a *Milky Juice*.

I. The Division of *Plants*.

II.
A Tree.

A Tree is a woody Plant, in thickness and height exceeding all the rest, whose stock is lasting, and one only by nature, which spreads it self into many Branches and Boughs, as an Oak, Pear and Fir-tree. I say it is lasting or perpetual, because it hath no certain time of duration.

III.
A Shrub.

A Shrub is a Plant of a mean thickness and height amongst those that are woody, whose Stem is manifold by nature, and which by cutting off its Shoots or Suckers, is easily changed into the nature of a Tree.

IV.
An Under-shrub.

An Under-shrub is the least of woody Plants in height and thickness, having a lasting Stem or Stalk, which sometimes is single, and sometimes manifold like Brushwood, with a small and slender Leaf, as Rosemary, Lavender, Southernwood, &c.

V.
An Herb.

An Herb is a Plant which consists only of Leaves, as Harts-tongue, &c. or sometimes of a Stalk, but perisheth away every year, and is not woody till after it be dried.

VI.
The Diversity of Plants may be deduced from several Heads.

The variety of Plants is assignable either to the Soil whence they grow; or to the Pores or channels through which their Alimentary Juice is conveyed; or to their Structure or Figure; or to the Fruits they bear; or to their differing Qualities, or lastly to the Changes and Alterations to which they are obnoxious.

VII.
From the Place of their Growth.

With regard to the place of their growth, some are upon Rocks, Walls, the Tops of Houses, when the water falling in abundance, doth leave some limosity upon those places. Some grow upon other Plants, or upon great Stones; as Moss which grows upon the Barks of Trees; and Touchwood which sticks to the Oaks and Nut-trees. Some proceed from the rotten Wood or Roots of Trees, as SCALIGER tells us, that Bearsfoot doth, Exercitat. 140. Others grow upon Dung-hills, as Sow-thistle, which Hogs delight in, and other such like. Some grow upon the Bodies of Living Creatures, as is related of a Shepherd, who had a little Plum-tree or Sloe-bush growing out of his Breast, because falling by chance upon one of them, he had forgot to pluck out one of the thorns of it which stuck in his Breast, and afterwards sprouted out thence.

VIII.
From their different Pores.

Plants are also distinguished by their Pores; for the Alimentary Juice, according to the different structure of the pores it passeth through, acquires a different Temperature and Qualities. According to which different disposition of the Pores, some Plants are more early in their coming forth, and others later. For those that want a Stalk, or have only a short one, are more slowly nourished: others that have a more favourable Texture of their Pores, and the Fibres of whose Stems are more yielding, grow sooner, and to a greater Size and Bulk, especially if the Climate and Soil agree with it. Thus Gourds and Sallows do in a little time encrease to a great Bulk; whereas on the contrary Oaks and Pine-trees, by reason of the straitness of their Pores, are as slow in their advance. And therefore because the Fir-tree, and others of that nature consist of looser and more open Pores than the Ebony-tree, and other-like hard and compact woods brought from Brazile, they are easily bent, but not without difficulty pulled asunder: whereas the parts of these latter are very Brittle and break upon the least bending, because of the very close and compact texture of their Parts. It is also from

this various disposition of the Pores, that the same Rain furnisheth nourishment to such a vast number of different Plants, because it is changed according to the difference of the Soil, and the variety of the Pores doth diversly affect the said moisture and alter it, so as to become the proper nourishment of such and such a Plant. To which may be added, that the Juice which is drawn from one part of the Earth, doth furnish it with other Alimentary Particles, than another doth.

But if any one ask, how the Juice ascends from the Root, into the wooden Fibres; they may take this for an Answer, that the Juice ascends in Plants, after the same manner as water mounts up into those Pipes that are made use of in the Experiments of a Vacuum; that is to say, because the weight of the Air drives them upwards. Which effect of the Air is much encreased by the Circular Motion of the Earth, for it being the Property of that Motion, to drive all the most agitated parts far from the Center; accordingly it also drives all the Juices of the Earth into the Pores of the Plants that are more agitated than the Air; whether this their agitation proceed from Subterranean Fires, or from some particular fermentation in the out parts of the Earth.

A great variety likewise ariseth among Plants from their Structure or Figure; for some are low, as Onions and other creeping Plants. Others grow to a vast Height, as Cedars whose height and thickness is wonderful; Historians mention one that grew in Cyprus to have been 130 foot high, and of that thickness that 3 men could scarcely fathom it. And so likewise the Fir-tree, Abies, which takes its latin name from Abire, that is, to go away, because of the vast height it off riseth to. Historians tell us, that in the Ship, that by command of the Emperour CAJUS brought the Obelisk, placed in the Vatican Circus or Piazza, from Egypt, there was a Fir-tree, whose Trunk was as much as 4 men with their stretched-out-arms could compass. Some grow of a round Figure, as Puffs, others in the form of an Umbrella, as Mushrooms. Some have the strings of their Barks extended long-wise, others a-thwart and Cross-wise. Some naturally have crooked Stems or Trunks, as the Vine, others strait and upright, as Reeds and most Trees.

Plants are also differenced according to their several Fruits: and thus some are called Glandiferous or Acorn-bearers, as the Beech, the Oak, the Cork-tree and the Chestnut-tree, which latter, for the goodness of its Fruit, excels the rest of the Trees of this sort. Others are Coniferous, bearing a Fruit like a Cone, that is smaller at one end and like a Top; such as is the Cedar-tree, which formerly grew in great abundance upon Mount Libanus, but are reduced to 24 only. So also the Cypress-tree, and the Firr, tho' this is reckoned amongst the Resiniferous or Resin yielding Trees. Others are Pomiferous, or Apple-bearers, as the Apple-tree, the Citron-tree, which is always green, of a most fragrant odor, and its fruit of a golden Colour; the Orange and Lemon-tree, the Pomegranate-tree, so called from the great number of grains of Seed which its Fruit doth contain; and the Apricot-tree, whose fruit, from the golden colour, were by the Greeks called Chrysomela or Golden Apples.

IX.
How the Juice of the Earth ascends in Plants.X.
From their Figure.XI.
From their Fruits.

OF

XII.
Of Nut-
bearing,
Berry-
bearing,
or Cod-
bearing.

Of Fruit-bearing Trees, some are Nuciferous or Nut bearers; as the Nut-tree and Almond-tree, which have their Fruit contained in hard Shells; others Pacciferous or Berry-bearers; as the Plum-tree, the Olive-tree, the Mulberry-tree, and the Cherry-tree, which bear a Fruit that consists of a more soft and moist flesh, and cover'd only with a thin Skin: Other Siliquiferous or Pod-bearers; as Cassia, Tamarinds, &c. because their Fruit is contained in Cods or Husks, or in a Juicy-shell, of a longish figure.

XIII.
From their
various
Propensities
or Inclina-
tions.

There is also a considerable variety in Plants, from their different Inclinations: For some of them have an Antipathy against others. Thus the Vine, and Cabbage or Coleworts, cannot endure the Neighbourhood of one another; and so likewise the Olive-tree and the Oak, the Bay-tree and the Vine, the Olive-tree and Coleworts, the Nut-tree and the Oak are at variance. Not by reason of any inborn Antipathy, as some do imagine; but because when those Plants stand near together, they rob one another of sufficient Aliment, because they are nourished with one and the same kind of Juice; which being taken in by the stronger and more vigorous Plant, the other must needs languish. And on the contrary, those Plants are said to be friendly to each other, which are nourished by different Juices; so that what is necessary for the Aliment of the one, is never touched by the other. And herein doth the Antipathy and Sympathy of Plants properly consist; according to what we have more largely explained in our History of Nature, concerning Plants. Thus the Fig-tree and Rue thrive in the Neighbourhood of each other, because they delight in a quite different sort of Nourishment; and not by reason of any Consent or Friendship, but by subtraction of the contrary Aliment, which the one draws to feed its sweet-scent, and the other to feed its bitterness. And on the contrary, Rosemary loseth part of its sweetness and savour, when it grows in the Neighbourhood of the Bay-tree or Lavender; because both these Plants delight in the same Alimental Juice, and are like Robbers one to another, whenever they stand close together.

XIV.
From Arti-
ficial Trans-
mutation.

A Diversity is likewise to be found in Plants that springeth from Transmutation; as when Plants are made more fair and beautiful, by the Art and Industry of Gardiners. Thus that vast variety of Gilly-flowers, proceeds from this Cause. And in like manner there is now the Calathiana, a kind of Violets, not only of Blew colour, but also White, Red, and of a mixed Colour, by the Curiosity of Ingenious Florists. For the Industry of Gardiners doth conduce much to the variety of Plants; according to what Virgil tells us in his First Book of Georgicks:

*I have seen many would Anoint their Grain,
With Nitre first, then Lees of Oil would spread;
That the Husk swelling might enlarge their Seed;
Then with lent Fire ripen the tender Grain.*

XV.
From the
Negligence
and Care-
lessness of
Gardiners,
&c.

And on the contrary, by the Negligence of Gardiners, or some fault in the Soil, Plants degenerate, and are turned into others not so good as themselves: So Wheat turns to Darnel, Basil into wild Thyme, Barley into Oats, Turneps into Rhabdib, as SENNERTUS assures us; Water-mint

into Spear-mint; the Blak-Vine into Briony, Spelt into Wheat, and Wheat into Spelt. It is also a common Observation, that if the same Seed be for several years together sown in the same Ground, it will degenerate; according to that also of VIRGIL:

*When oft the fairest Barly itb' same Ground
we sow,
Darnel instead thereof, and blasted Oats do
grow.*

The same happens almost to all Plants, when they are transpos'd to different and disagreeing Places: As when Herbs that grow in Pools and Running-water, are removed to the Tops of Hills, or Champion-ground. Thus if the Water-flag should be transplanted to Hilly-ground; or the Seed of Lettice, Cucumber and Cabbage, to a Sandy place: And on the contrary, Heath, Fern and the Thorn-bush, to moist and Marshy-ground; they would soon degenerate to other Plants, and cease to answer to their Names.

CHAP. XII.

Of the Propagation of Plants.

PLANTS may be propagated or multiplied several ways; as either by Seed, or by a Sprig cut, or pluck'd off from the Stock and set into the Ground; or by Grafting.

But before that the Seeds of Plants are committed to the Earth, the Soil must be duly prepared; that is, it must be turn'd up by the Plough, or dug with a Spade, or cut with a Weeding-Hook, or broke with a Pick-ax, and the Clods broke with a Harrow or Rake. All which pains is taken, partly to root out the Weeds and unprofitable Herbs; and partly to make the Ground more light and loose, that the Seeds or Slips may the more easily take root in it, and spread their fibres far and near, and by this means attract a more copious Aliment.

Nature directs us to the most proper Seed time, viz. when the Seeds have attained their full growth and maturity; or, when by the opening of their Husks they fall to the Ground; or by the contraction or shrinking of them are thrust out; or by the Down that grows about them, they are by the Wind scatter'd up and down through the Air.

The other way of propagating Plants, is by setting a Sprig or Slip, whether cut or pluck'd quite off, or whilst it sticks yet to its Mother, thrust down into and cover'd with the Earth, till it hath taken root. These Sprigs or Slips may be bigger or less, according to the Nature of the Plant. For some are set from a greater Branch, others from a Slip, others from a Twig, and others from a Shoot.

The Twigs, Sprigs or Slips that we would set, must be fresh and green: Yet VIRGIL tells us, that the dry Sprigs of an Olive, if set, will grow notwithstanding:

*An Olive Branch, tho' dry, will shoot,
If set itb' Earth, and spread its diving Root.*

I.
Plants are
propagated
by Sowing,
Setting, and
Grafting.

II.
The Soil
is to be
prepar'd
for the
Reception
Seed.

III.
The fittest
time for
Sowing.

IV.
Of Propa-
gating
Plants by
Slips or
Sprigs.

V.
What kind
of Twigs
or Sprigs
are to be
Set.

It is also observable, that the more tender any *Plants* are, the later must their *Sprigs* or *Slips* be set, that is, about the middle or latter end of the *Spring*, in these colder *Climats*: And if the *Weather* permits, they must be watered as soon as set; I say, if the *Weather* permits; for in cold *Weather*, too much *Moisture* is apt to spoil them. And so also, if it be a clear *Sky*, and the *Sun* shine hot upon these new set *Twigs* or *Slips*, they must be shaded, lest the heat of the *Sun-beams* should scorch and dry them up.

VI.
What Graffing is, and how it is performed.

In the Second place, *Plants* are propagated by *Graffing*: Now *Graffing*, being taken in the largest Sense, is such an application of a *Graff* or *Bud* to its own *Stock* or *Branch*, or to that of another *Tree*, whereby they become united and grow together. Now forasmuch as the most part of the *Sap*, ascends between the *Inner Bark* and the *Wood*, the whole Art of *Graffing* consists in this, that the *Inner Bark* and *Wood* of the *Stock* and *Graff* do answer exactly one to another; or that the *Scion* or *Bud* be so applied to the *Stock* or *Branch*, that the inner and outward *Bark* both of the *Stock* and *Scion* may so exactly answer, and make one continued *Body*, and one Even *Surface*, that the *Juice* may readily and freely flow from the *Stock*, to the *Graff* or *Bud*.

VII.
What Graffing is, and to what end it is done.

The End of *Graffing*, is to meliorate the Nature of *Plants*, by changing them into others. For since there is a twofold *Concoction* of *Food*, the one in the *Stock*, and the other in the *Graff*; it cannot be otherwise, but that the *Alimental Juice*, by these different *Strainings*, must be the better prepared, and partake of new *Qualities*: And therefore we find, that *Plants* by *Graffing*, do not only bring forth larger, but also better *Fruit*, than the *Tree* doth from whence the *Graff* is taken: And it is found by Experience, that the *Tree* which grows from the fruit of a *Graffed-tree*, or the *Sprig* thereof set in the *Ground*, doth bring forth less and meaner fruit, than doth the *Graff* it self, from whence it was taken. Hence it is also, that we see one and the same *Tree* laden with diverse *Fruits*; yea, and the same *Fruit* having a different taste, smell and colour, in one part of it, from that it hath in the other, as also late *Ripe Fruits* to become early *Ripe*, and such as are *Green* to become *Red*.

VIII.
There be three ways of Graffing: The First is Infoliation.

There be three ways of *Graffing*: The first is within the *Inner Bark*, when the *Graff* is put in between the *Wood* and the *Bark*, and is ty'd fast with a *Thread* or small *Cord*. This way of *Graffing* is most proper for *Trees* that have a thick *Bark*, and abound with *Sap*: Because the *Bark* draws abundance of fat *moisture* out of the *Earth*; such as are the *Fig-tree*, *Cherry-tree* and *Olive-tree*. Wherefore, he that would *graft* after this manner, must have a little *wedge*, made of some very hard *Wood*, and drive it in between the *Bark* and the *Wood* gently, so as not to rend the *Bark*, and in that aperture must *graft* his *Scion*. This way of *Graffing* was by the *Ancients* called *Infoliation*, and is still in use with us, where the *Bark* is thick, and a small cleft to *graft* in cannot so well be made.

IX.
The second way of Graffing is in a

The second way of *Graffing* is, by means of a *Cleft* made in the *Stock*, into which the *Scion* is put, so as that the *pith* of the one may be joyned with the *pith* of the other; and then the *slit* must

be stopt up with *Clay*, and bound up with the *Bark* and *Moss*. This way of *Graffing* is made use of in those *Trees* that have a thin *Bark*, and are of a drier *Complexion*, their *Moisture* living not much in the *Bark*, but within the *Pith*; such as are the *Citron-tree* and *Vine*. And this way is properly call'd *Graffing*, which must be quickly done, lest the *Scion* which is to be *grafted*, should by delay become over dry.

The third way of *Graffing* is done by *Inoculation*, wherein the *Bark* of the *Scion* that is to be *Inoculated*, is so joyned to that of the *Stock*, whence the like quantity of the *Bark* is taken, that the *Buds* and *Eyes* of the one, may exactly answer to the *Buds* and *Eyes* of the other. For there is a certain fat clammy *Moisture* between the *Rind* and the *Stock*, by which the *strings* of the *Scion* are glewed and joyned to the *strings* or *fibres* of the *Trunk* or *Stock*.

There be other ways of *Graffing*; as that which is done by *Emplastration* or *Plastering*, whereby some part of the *Bark* of a *Scion*, with its *Buds*, is put into the *slit* of the *Bark* of a *Stock*, and the *Bark* of the *Stock* so closed again upon it, as that no mark of the *slit* remains; and afterwards is plaister'd and bound up. Another way is by *Boring*, when the *Graff* is put into the *Hole* that is bored into the *Stock*. There is also another way, which the *French* call *En perche*, when many little *Sprigs* with their *Buds* are *grafted* into a perforated *Perch*. But all these, and other such like, are reducible to the 3 ways already mention'd: Forasmuch as all of them agree in this, that the *strings* of the *Sprig* or *Bud*, must agree and answer to the *strings* of the *Stock* whereinto they are *grafted*; and that by this mixture or coalescence, the wound may be cover'd or grow together, leaving the *Bark* somewhat rough in that place. They agree also in producing the same effect, that is, the melioration of *Plants*, by reason of their *Cocction*, both in the *Stock* and in the *Graff*, where the *Alimentary Juice* is further prepar'd and purified.

By this Art of *Graffing*, not only *Trees* of the same Nature are mingled, as it were, and united; as *Apple-trees* with *Apple-trees*, *Pear-trees* with *Pear-trees*, &c. but also any other *Trees*, tho' never so different in Nature. Yet they who would have their *Grafts* to thrive, had best set them on a *Stock* of the same kind; because the *strings* of *Plants* that are of a like Nature, do better agree together, and have their *pores* and *passages* dispos'd in one and the same manner. However it is observ'd, that in process of time the *Seed* of the *Graff* doth very much degenerate: The Reason whereof is, because the *Seed* proceeds from the *Matrix* or *Pith* of the *Tree*, which being the product of the wild *Stock*, by degrees affects the *Seed*, and makes it to degenerate.

Some, it may be, will question how it comes to pass, that the *Scion* unites with the *Stock*, seeing that their *pores* do not answer to one another, but differ in their situation and figure. To which I Answer, That it is not necessary that all the *pores* of the *Stock* should agree with those of the *Graff*, or that every one of both their *strings* should be united; it being sufficient if the greatest part of them answer to each other, and give way to the passage of the *Alimental Juice*. As we see that 2 pieces of *Glass* laid upon one another, tho' all the

X.
The third way of Graffing is called, Inoculation.

XI.
All other ways of Graffing are reducible to these three.

XII.
The Nature of the Graff becomes changed in process of time.

XIII.
What Part of the Stock corresponds to the Pores of the Graff.

the pores do not exactly agree, do notwithstanding transmit the *Light*. For we must not imagine, that the *Graff* is joyned to the *Stock*, into which it is *grafted* with the same firmness and evenness, as its own connatural Parts are; since it hath often been found, that in an *Old tree*, the Part that hath been grafted on it, hath been torn off by a strong *Wind*, tho' for many years together, it had been united to it no otherwise, than as if it had been a Connatural part of it. For in order to the conveyance of the *Juice* from the *Root* to all the parts of the *Tree*, it is not necessary that all the *Pores* should exactly agree; because we find that the *Earth* affords Nourishment to *Plants*, notwithstanding that their *Pores* do not every way agree with those of the *Earth*. And tho' we should grant, that such a conformity of *Pores* should be necessary for the common Nourishment of the *Stock* and the *Graff*; yet I see no reason, but that the same conformation may be wrought in process of time, because the *Sap* that comes from the *Root* hath power of making to it self *Channels* and *Passages*, as hath been hinted before: For the *Fire*, by the motion whereof it is driven upwards, thrusting it forwards, helps it to make these *Passages* and *Channels* for it self.

XIV. In Grafting, many things are to be observed.

To the end that *Grafting* may be duly performed, we must take heed, *First*, That the *Scion* to be *Grafted*, be not too soft or tender; for then, because of the tender texture of its *strings*, it will not be able to bear the hardness of the *Stock* into which it is *Grafted*. Neither on the other hand must it be too dry; for in that case it will not unite and grow into one with the *Stock*. *Secondly*, That the *Graff* be taken from a fruitful and good *Tree*, and, as near as may be, of the same kind; as the *Graff* of an *Apple-tree*, upon the *Stock* of an *Apple-tree*. For if they be of different kinds, the *Fruit* thereby becomes spoiled; as if one should graft an *Apple-tree* upon a *Willow* or an *Ash*, the *Apples* will be found like to a *Crab* or *Wilding*. *Thirdly*, That the *Scion* be without any delay grafted, lest the *Air* entering into the *Pores*, should hinder their growing into one. *Fourthly*, That the *Stock* be duly slit, lest the slit being made too deep, should hinder the closing of it up again. *Fifthly*, That the *Graff* be so cut, as that the *Woody part* of it may joyn with the *Wood*, and the *Bark* of it with the *Bark* of the *Stock*. *Sixthly*, That the *Stock* on which we intend to graft, have stood in the ground for some Months, lest in case it should not be well rooted, it might not furnish *Sap* enough to feed its young Nurfing. *Seventhly*, The top of the *Scion* is to be cut off, that by beating back the *Juice* it may swell and grow bigger. *Eighthly*, That when the *Graff* is put into the slit, the place must be pasted about with *Wax* and *Gum*, or with *Clay* and *Moss*, to keep out all external Moisture. *Ninthly*, That a fit Season of the Year be observed; which is, after the *Winter Solstice*, and after the Blowing of the *West Wind*; that is, from the 7th of *February* to the *Spring Solstice*. *Tenthly*, It is also to be noted, that some *Trees* are altogether unfit for *Grafting*; as the *Oak*, the *Fir-tree*, and other *Resiniferous-trees*; because the *Oak*, by reason of its hardness, will not be slit; and when slit will not grow together again: And *Resiniferous-trees*, because of their clammy *Liquor*, have their pores so obstructed, that the *Juice* cannot be readily

conveyed to the *Graff*. And, *Eleventhly*, That the parts of the *Scion* may retain the same situation when grafted on the *Stock*, as it had before it was cut off from its own *Tree*: As by Example, If the *Graff*, before it was cut off from the *Tree* did lean towards the South, in *Grafting* it must likewise be turned that way. See the *Natural History concerning Plants*.

CHAP. XIII.

Of the Colours of Plants.

AS to our present purpose, it is sufficient for us to know, that *Colours* are nothing else, but certain modifications of *Light*, caused in Bodies by the different disposition of their Surfaces. Whereof we have a manifest proof in cutting of an *Apple*, the inner parts whereof appear white at first; but soon after turn yellow, and lastly become of a brown Colour, according as its outward parts are more dried. Such a modification of *Light* does especially belong to *Plants*, since that all their parts are ting'd with some Colour or other, and are remarkable for their whiteness, yellow, red Colour, &c. yea, and sometimes are successively green, yellow, red or white, according as the Texture of the little particles, whereof they are compounded, is changed, and the disposition of the surface alter'd. The Matter therefore in question is, What that is in *Plants* that makes the *Light* reflected from them to acquire such and such Modifications, which impress these Sensations on the Eye.

The *Roots* of *Plants* are generally white; because they contain much *Spermatick matter*, which being compressed by the *Earth* that lies round it, and hindered from flying up into the *Air*, is forced to return into the substance of the *Plant*; where, by the warmth of the inner part of the *Earth*, it is concocted anew, and being coagulated into a kind of frothy Substance, doth reflect the *Light* on all sides, and so produce a white Colour. For the Reason why *Snow* and *Froth* are white, is, because they consist of little round Bodies, which from every point reflect the *Sun-beams*. For the smaller these Bubbles are, the more white doth the Subject appear; for seeing that every one of them, from all their parts reflect the *Light*, it must needs follow, that the more there are of these, within that determinate Space, the more Rays will be reflected; that being a white Colour, which comes nearest to the Nature of *Light*. Hence it is that *Liquor*, tho' it be of never so black a Colour, turns white as soon as it is turned to *Froth*; as appears in the froth of *Ink*; and therefore it is no wonder that the Root of a *Plant* being cover'd with *Earth*, appears white, because it consists of clammy Humours, which by the warmth of the *Earth* is easily turned into little round Pellets.

And it is for the same Reason that a *Lilly* is white; because the surface of it riseth into Bubbles, from all the several parts whereof it reflects the *Light*. For in a *Lilly*, the Alimential Juice is very exactly percolated, and its substance being well concocted, turns to round pellets or bubbles. In like manner as we see, that our food becomes turned into Chyle, when after digestion in the Stomach, it is resolved into little round Bodies; which

I.
What Colour is.

II.
Why the Roots of Plants are commonly White.

III.
For the same Reason a Lilly is White.

Chyle

Chyle afterwards in the *Breasts* becomes turned into *Milk*. The Reason therefore of the *whiteness* of a *Lilly* is, because the little *Skin* wherewith its *Substance* is covered, consists of round *Pellets*, as is manifest to those that look upon it through a *Microscope*.

IV.
Whence the
Red Colour
that is in
Flowers
proceeds.

Some *Flowers* are *Red* as *Roses*, and *Tulips*, because their parts are so disposed that the *Globuli* of the Second *Element*, which constitute *Light*, are by them more swiftly whirl'd about than they move to right lines. Wherefore whensoever the *light* in any *Body* is so modified, that its *Aethereal Globuli* are more swiftly turned round, than they move right forwards, than the surface of those *bodies* from whence the *Light* is reflected appears *Red*. Thus a *white Flame*, when *smoke* comes to it, turns *Red*. The *Sun* through a *Mist*, the *Planet Mars* by night, the *Moon* in the *Clouds*, a glowing *Coal*, and many other things are *Red*. Some *Fruits* therefore as *Cherries*, *Grapes*, *Mulberries*, &c. are of a *Red Colour*, because the *Juice* whereof they consist, having never been exactly strained, and therefore containing several *Particles* that are not sufficiently digested, makes those *Fruits* to appear of that colour, by reflecting the *Light* accordingly.

V.
The Cause
of the Yel-
low Colour
that ap-
pears in the
Leaves of
Plants.

A *Yellow Colour* is peculiar to the *Leaves* of *Trees* and *Fruits*, whilst they are ripening; because having lost the moisture, which gave them their *Greenness*, they now contain nothing but such a *Juice*, as is well strain'd and prepar'd; which makes their outside to rise into greater *Bubbles* or round *Bodies*, which because they leave great intervals between them, must needs cause a great variation in the *Reflexion* of *Light*. For if you look upon *Yellow Bodies* with a *Microscope*, you will find them wholly rough and uneven, and full of innumerable protuberances; by which means the *Light* reflected from them becomes so modified, that the *whirling* about of the *Globuli* is somewhat more rapid than their *motion* to right lines. For the *Yellow Colour* mediates betwixt *White* and *Red*; which may be demonstrated to the *Eye* from the mingling of *Liquors*; for if you mix any *White* and *Red Liquor* together, the result will be *Yellow*. And the same will be if we twist a *Lace* or *Girdle* of the smallest *White* and *Red Threads*.

VI.
The Blue
Colour is
peculiar to
some Flow-
ers.

Blue is the peculiar *Colour* of some *Flowers*, because the *Juice* that nourisheth them, is in such a manner concocted and percolated, that from thence such a degree of *Darkness* and *Transparency* results, as produceth such a *Reflexion* of the *Rays*, that the *Globuli* of them, have more of a straight, than of a circular *motion*. For a *Blue Colour* comes between a *Black* and *Red*; as appears in the *Air*, which in the day-time looks *Blue*, by reason of the *Bodies* that are tost up and down in it, and reflect the *Rays* to us. And forasmuch as these *Rays* are but few in number, and the *Shades* many, therefore it is necessary that the *Heaven* should appear of a middle colour between *Black* and *Red*, that is of a *Blue*, in the day-time. This will be made manifest to us by mixing a very fine *Red Powder*, with another that is *Black*, or by laying a black *Glass* upon a red *Glass*, and looking through them, for by either of these ways we shall find a *Blue Colour* produced.

VII.
The Gene.

The most common colour belonging to *Plants* is the *Green*, which is observed in all of them as

well at their springing out of the ground, as in their growth. The cause of this *Colour* is the abundance of *moisture* that is in *Plants*, when it is but slightly strained and elaborated. Hence it is that those *Herbs* and *Leaves* have more of this *Greenness* by how much the more they abound with *moisture*, and less of it, as the *moisture* is less, and better digested. This *Green Colour* is mixed of *Yellow* and *Blue*; which may be made out by several experiments; for if we look upon the *Sky*, which is *Blue*, through a *Yellow Glass*, it will appear *Green*; so likewise if we lay a *Blue Glass* upon a *Yellow*, and look through it upon any *Object*, it will appear *Green*: and so we shall find that by mixing a *Blue* and *Yellow Colour'd Liquor* together, the mixture will be *Green*.

There be many *Flowers* that are of divers colours, as *Tulips*; which cannot proceed from any other cause, but the different concoction of the *Alimental Juice*; because the matter is better preserved and purified in the great *Bulbous Roots* of *Tulips*; and better strained through their long and thick *Stalks*, wherein also it is the better concocted and distributed. But yet it cannot be expected that *Tulips* every year should retain the same colours; for the temper of the *weather* changing considerably every year, it cannot be otherwise but that thereupon a different concoction, preparation and distribution of the *Alimental Juice* must follow, and consequently the colour also be changed. Yea, we find sometimes that *Tulips*, in one and the same year do change their colours, and that such as before were *White*, turn *Red*, and the *Red*, *White*. When streaks of a *Purple Colour* appear in a *white Tulip*, it is a sign that the thicker parts of the *Juice* do cause an obstruction, whereby the free motion thereof to the utmost parts of the *Flower* is hindered.

And the same may be said of the *Leaves* and *Fruits* of *Trees* changing their colours. For the *Leaves* are *Green* at first, by reason of the plenty of *Moisture*, and the *Juice* that is not thoroughly elaborated or prepared; and from this *Green Colour* they are changed into a *Reddish*, and lastly from that to a *Yellow*; because the *Moisture*, which at first was the cause of the *Green Colour*, being diminished gives way for the *Red Colour* to succeed, and afterwards flying all away, they are thereby changed into a *Yellow Colour*, till at last extreme dryness turns them *White*. In like manner *Fruits*, as it comes to be ripe, quits its *Green Colour*; which becomes changed into some other; because the *Juice*, which before was raw, as wanting due preparation, when the *Fruit* grows ripe, becomes depurated and percolated to perfection: so that the contexture of parts being by this means changed, it is no wonder that the *Fruit* loseth its *green Colour*, and becomes *Red*, or *Yellow*, or of a *Colour* mixt of both.

CHAP. XIV.

Of the several Tasts of Plants.

BY the word *Tast* or *Savor*, we understand that *virtue* in *Bodies*, whereby they are able to produce in us the *sense* of *Tast*. Which virtue consists in the *Particles* of *Bodies*, inasmuch as they are sufficiently diluted, subtil and agitated to

ral Colour
of Plants is
the Green
Colour.

VIII.
What is the
Cause of
that variety
of Colours
that is in
Tulips.

IX.
Why
Leaves
and Flow-
ers change
their Col-
ours.

I.
What
Tast
or Savor
is, and
wherein it
consists.

Oni-
Pepp-
hary
Sma-

to enter the pores of our *Tongue*, and to move those *Nerves*, wherewith the *Instrument of Tasting* is furnish'd. For tho' *Taste* be properly in the *Mouth*, and that the *Tongue* or *Palat* is formally that which *tastes*; yet it may be said, that the things themselves, which are taken into our *Mouths*, are the Causes of the said *Taste*, and according to their several *magnitude*, *figure* and *motion*, do produce different *tastes* or *savours*. So that things *savoury*, or endued with *taste*, are said to be such, only because they move the *Filaments of the Nerves* of our *Tongue* in such a manner, as is necessary to produce in them the *sense of Tasting*. And forasmuch as *sensible Objects* cannot affect those *Nerves*, except they be endued with a certain *motion*, *figure*, and *magnitude*; therefore to these three we must assign all the diversity of *Tastes* or *Savours* we meet with in any *Objects*.

II. This is evident from the *Inspidness* we sometimes find in *Plants*, and their several parts. For if we enquire into the Reason why some of them are *Inspid*, and do not affect the *Tongue* or *Palat*, we shall find the Reason to be, because they do not furnish such *Particles*, as by the assistance of *Moisture* can enter the *Tongue*, and strike its *Nerves*. Thus we find, that when *Grapes* are first knotted, they impress no affection upon the *Tongue*, and do only touch the outside of it, without entering its pores; because the *particles of Juice*, which come up from the *Root* to compose them, do stick close together, and are not easily separated. Daily Experience also teacheth us, that *Water* is in a manner wholly inspid, because its *Particles* are so thin and subtil, that they can affect the *Organ of Taste* very little or nothing. In like manner *Air* is void of all *Taste*, because it floats only upon the *Spittle*, and the Parts of it, by reason of their extream lightness and subtilty, can make no impression upon the *Tongue*.

III. That a thing be *savoury*, it is necessary for its Parts to be separated from each other, that so joining themselves to the *Spittle* in our *Mouths*, they may variously affect the *Nerves* of our *Tongue*. Now this is done by means of *Heat*, the Property whereof is, to resolve *Bodies*, open their pores, and to make a ready way for the *Moisture* to enter. Whence it is, that when *Fruits* tend to Maturity, by means of the heat of the *Sun*, reconciling their *driness* and *moisture* together, various *Tastes* are impress'd upon them, according to their different degrees of Maturity: First, an *Astringent taste*, then a *Harsh taste*, afterwards a *Sour*, and last of all, a *Sweet taste*; and if the *Heat* be too great a *smart* or *biting*, and *bitter Taste*.

IV. An *Astringent taste* we find in all unripe *Fruit*, and more especially in *Sloes*, which with great *harshness* and *astringence* affect the *Tongue*, as if they prick'd it with *Pins* and *Thorns*; because they consist of *keen* and *stiff Parts*. For the *Juice* whereof they consist being not well strained, contains many stiff and inflexible little *Bodies*, such as are the *particles* that compose *Salt*; so that it is no wonder that they exasperate the *Tongue*, and astringe or contract the same.

V. In *Onions*, *Ginger*, *Pepper*, *Mustard-seed*, &c. we perceive a *smart* and *biting Taste*; because the *particles* of these *Objects* do prick the *Tongue*, and cause the same Division in it, which *Fire*

would, if applied to it. The Reason is; because they consist of long, thin, and stiff *particles*, which make the *Bodies* whereto they belong dry and stiff. But being boil'd in *Water*, they lose their *Acrimony*; for that the *Moisture* penetrating them, dissolves their *Salt* and other smart little *Bodies*, and opening their pores, carries them away. Yea, some of these may be so macerated or soaked, as that by quitting all their *Biting* and *Harsh particles*, they may become *sweet*, and at last *insipid*.

We meet with a *Sweet taste*, almost in all *Ripe Fruits*, which with great smoothness and evenness affect the *Tongue*. For in *Ripe Fruits*, by the continual beat of the *Sun*, the *Alimental Juice* is very exactly and thoroughly strained, and the *particles* that before were entangled, are resolved, by which means they readily enter the pores of the *Tongue*, and affect it with a pleasing *Titillation*. This *Taste* is most pleasant and grateful to young *Children*, the small strings of whose *Nerves* are more fine, small and subtil; but is not so acceptable to those who have a thicker *Texture* of *Nerves*, being affected by what is *acrimonious*, and therefore look upon a *sweet Taste*, to be unpleasant.

A *Sour taste* is found in *Lemons*, *Sorrel*, and the like, which do prick and cut the *Tongue*. It is felt somewhat in the same manner, as a *smart* or *biting Taste*, saving only that *Sour things* are accompanied with a *sense* of constringent *Cold*. The Reason is, because this *Savour* consists in subtil and sharp *Particles*, which do easily penetrate the *Organ of Taste*, and pierce it like so many *Thorns*. And therefore we must conclude, that these *Bodies* consist of longish and stiff *particles*, somewhat like *Needles*: Which we shall readily admit, if we consider that all *Fruits*, before that they come to their full *Ripeness*, are of a *Sour taste*; which could not be, if that *Taste* did not include something that is common to them all. Now we can meet with nothing that is common to them all, except that *Disposition of Parts*, seeing they consist of an *Earthy Juice*, which did cleave to the long and thin pores of the small *Twigs*, whence these *Fruits* do grow.

A *Bitter Taste* is perceived in some rotten *Pears* and *Apples*, &c. in the eating whereof the strings of the *Nerves* are unduly affected, and unpleasantly vellicated. For *Pears* and *Apples*, when they begin to putrify, get rough, uneven, and prickly *particles*; because then the more subtil and refined *particles* fly away, leaving none but the grosser and thicker behind them. For *Putrefaction* is such a *Resolution of Parts*, by which things become worse than they were before. Hence it is that they who drink *Wine*, immediately after they have eaten a tainted *Apple*, and tending to *putrefaction*, do perceive a *Bitter taste*; because the *Wine* mingling it self with those putrid *particles*, conveys them to the inmost pores of the *Tongue*. This *Bitterness* is sometimes occasion'd by too great *Heat*, when it is continual, and acts for a long time together upon *Fruit*. So that if *Fruits*, after their full Maturity, should continue long upon the *Trees*, it is not to be question'd, but that by being too long expos'd to the *Heat* of the *Sun*, their *particles* would become so rugged and twisted, that none would be left in them, to affect the *Tongue* with a *Sweet taste*, but would all ex-

biting
Taste.

VI.
How Sweet-
ness is pro-
duced in
Ripe fruits.

VII.
A Sour
taste proper
to Lemons.

VIII.
Whence
that Bit-
terness that
is observed
in Rotten
Apples,
does pro-
ceed.

asperate and bite it. A confirmation whereof we have in *Flesh*, which by too great *heat* of the *Fire* becomes scorched and burnt, and by this means acquires a *Bitter taste*, as doth also the *Crust* of *Bread* that is burnt, by being baked in an over-heated *Oven*.

IX.
Mixt Tastes
are found
in some
Fruits and
Plants.

Neither are these simple *Savours* or *Tastes* only found in *Plants* and *Fruits*, but also compound *Savours*; as the *sweet* and *sour Taste* which is commonly found in *Fruits*, that are not yet arrived to the utmost degree of *Maturity*: As when some of their *parts* are longish and stiff, which prick the *Tongue*; whereas others, more smooth and pleasant, softly flowing over the *Nerves* of the *Tongue*, do only produce a kind of pleasant *Titillation* on the *Tongue*. Another *Taste* is that which is *Harsh* and *Sour*, which is that we perceive in those we call *rough Wines*. Another, *Sour* and *Astringent*, which *taste* is found in the *Juice* of *unripe Grapes*, called *Verjuice*; the Cause whereof is this, that the *particles* which constitute the *Grapes*, are by the *Heat* of the *Air* separated from each other, and so acting independently, they produce both a *sour* and *astringent Taste*.

CHAP. XV.

Of the Odour or Scent of Plants.

I.
Wherein
Taste and
Scent do
agree,

O Dours, or *Scents*, have some affinity with *Tastes*, as being much deriv'd from the same *Principles*. For as *Taste* consists in those little *Bodies* which penetrate the *Tongue* and *Palat*, and diversly affect them, according to their various *Magnitude*, *Figure* and *Motion*; so *Odour* consists in those *particles* which, flying in the *Air*, do enter our *Nostrils*, and variously affect the same. There is also another *Resemblance* between them, in that they are in a manner denominated alike, and are distinguish'd by the same *Differences*. For as *Tastes* or *Savours* are chiefly distinguish'd into *Astringent*, *Smart* or *Biting*, and *Sweet*: So of *Odours* or *Scents*, some are *sweet*; as in *Musk*, *Roses*, *Orris*, &c. Others *smart* and *stinging*; as in *Brimstone*: Others, *stinking* or *nasty*; as in *Bugs*, and some *Excrements*: Others, *sharp*, as the *Scent* of *Spike*, &c.

II.
How Sa-
vours and
Odours
differ.

But yet *Scents* and *Tastes* differ in this, that they do not consist in the same *parts*, nor affect the *Organs* after one and the same manner. For the *particles* that are productive of the *sense* of *Taste*, are moist; whereas those that cause *Odours*, are very dry and subtil. They differ also, in that a *savoury Object* cannot move the *sense*, except it touch the *Organ*; whereas a *scented Object* strikes the *Organ* at a distance: So that the *Tongue*, by its *Moisture*, takes out the *Taste* from the *Object*; whereas the *Nostrils* only admit the *Odour* transmitted to them from the *Object*.

III.
The Nature
of Odours
consists in
the efflux of
Particles.

Whence we may conclude, that the Nature of *Odours* consists in the *Efflux* of certain *particles*; which being diffus'd in the *Air*, enter the inmost parts of the *Nostrils*, and there affect some *Nerves* derived from the *Brain*. This we perceive in *Frankincense* cast upon *Coals*, and any other *Perfume*, which evaporates in the *Air*, and is dispers'd into innumerable *particles*. Whence it is that *Hard Bodies*, which in their compact Nature afford

no *scent*, when put to the *fire* yield an *Odour*; because, by the forceable *motion* thereof, some of those *particles* are set at liberty, and diffus'd through the *Air*. 'Tis for this Reason, that *Spanish Wax*, which we make use of to *seal Letters*, doth yield a *sweet Scent*, when put to the *fire*; as also that one *Stone* rubb'd against another; and *Iron* violently struck by another *Iron* do send forth a *smell*, which before this motion was not perceptible. From which Instances it may appear also, that the *Odours* of *Flowers* consists in an *Exhalation* or *Evaporation* of some of the *parts* of them, which is the more evident, because when that is gone, they remain void of all *smell*.

Neither must we conclude from hence, that all manner of *Effluvia* that proceed from *Bodies*, must impress the *sensation* of *Odour*; for besides the emanation of *particles*, it is required that they move the *Organ*, and that in such a manner as is fit to produce this *sense*. For the *particles* of some *Bodies* may be so very fine and small, that they cannot sufficiently move the *Organ*: Thus we find, that neither the *Air* we draw in, nor the *Vapours* that arise from the *Water*, do excite any *sense* of *Smelling* in us. And on the contrary, some *Effluvia* are so gross, that they cannot reach the *Organ* of *Smelling*; or if they do, are more apt to spoil it, than to produce any *sense* of *Smelling* in it.

The Diversity of *Odours*, for the most part, depends on the same *Principle*, whence the variety of *Savours* doth proceed; that is, from that difference there is in the *magnitude*, *motion* and *figure*, of those *particles* that breath out from *Odorous Bodies*. Which we shall more readily assent to, if we consider that there is some *Analogy* or *Resemblance* between *savoury* and *odorous Objects*; and that those which agree in *taste*, do generally agree in *smell* also. Thus all *smart* and *biting Things* to the *taste*, are also observ'd to have a *sharp* and *stinging Smell*; and *bitter Things*, to have a *scent* that partakes something of *Bitterness*. The Reason whereof is, because the same *Particles*, which being mingled with *Moisture*, produce *Taste* or *Savour*, when exhal'd into the *Air*, and entering our *Nostrils* create the *sense* of *Smelling*. In like manner *Bodies* that are insipid, are commonly also destitute of *scent*. Thus *Unripe Fruits*, which have no more than an imperfect *Taste* (and the same may be said of *Flowers*) yield little or no *Odour*. I said, that it is so for the most part, because it sometimes happens, that there is not this agreement between the *Taste* and *Scent* in *Objects*; as appears in *Roses* and *Myrrh*, which tho' they yield a pleasant *smell* to the *Nostrils*, yet have a bitter and unpleasant *Taste*.

Nothing more conduceth to the production of *Odours*, than *Heat*; because it readily opens and resolves *Bodies*. For as we see that *Smoke* is excited by *Fire*, and that the more subtil *parts* of the *Wood* are carried up into the *Air*: In like manner *Heat* divides the parts of *Bodies*, dissolves their *Texture*, and makes way for them to fly abroad. For we observe that *fruits* and *flowers* smell by so much the more, as their *Juice* is better prepared by *Heat*, and more thoroughly digested. A *Lilly*, the more it hath been concocted with a lasting *heat*, the more *odorous* it is. *Sweet Woods* and *Spices*,

IV.
Why some
Bodies
have no
Scent at
all.

V.
The differ-
ence of
Odours de-
pends on
the variety
of Parts,
that flow
from a
Body.

VI.
Why Odours
are more
perceived
in Hot
Seasons
and Climates.

Spices, the better the Countries are they grow in, the more strongly Sweet-scented they are; as appears in *Frankincense*, *Storax*, *Myrrh*, *Balm of Gilead*, &c. Because the Juice of Plants in those Countries being exceeding well digested, is the more easily resolv'd into an *Odoriferous breath* or *steam*. Wherefore it is not to be wondred at, that the Plants that grow with us are not so odorous, as those that grow in *Arabia*, and other hot and dry Countries; because the Concoction cannot be perfected for want of *Heat*, the superfluous moisture hindring the more dry particles from exhaling into the *Air*. Hence it is that most things, when dried, do acquire a stronger *Odour*; and for the same Reason, *Ripe Fruits* are more and better scented, than those which are unripe. This proves all *Odorous things* to be hot, and that they suffer a continual efflux of their parts. And therefore those who would preserve the Sweet-scentedness of *Musk*, do wrap it in *Cotton*, which doth entangle its *Effluvia*, and hinder it from exhaling too fast. Accordingly also we find, that in *Colder weather* scents are dull and weak, because *Cold* stops the Pores of Bodies, and by keeping their parts at rest, hinder them from breathing out in *Exhalations*.

VII. Flowers are observ'd not to smell so sweet near at hand, as at a distance, if it be not too great. The Reason is, because they who put the flowers to their *Nostrils*, do take in many *Heterogenous parts* of *Herbs*, which are mingled or entangled with those of the flower, but are not able to accompany them at any distance, but are soon scatter'd in the *Air*, or fall down, because of their *Thickness*. Hence it is that a small quantity of *Civet* smells sweet, whereas a greater quantity of it rather stinks, and offends the smell. To which we may add, that the *Odorous Exhalations* scatter'd in the *Air*, become there strained and defecated of their more gross and impure parts; as we see that *Water* mingled with *Wine*, doth dull and weaken the smell, as well as the strength of it; and therefore it is no wonder, that an *Odorous Exhalation*, that hath been diffused through the *Air*, is more grateful, than that which we draw from the Body it self, apply'd to our *Nostrils*.

VIII. Forasmuch as Bodies continually send forth some of their Particles, we must conclude they cannot but waste by degrees. So we find, that those Sweet-scents that are excited by *Heat*, do waste by degrees, and at last lose all their *Odour*. But those *Perfumes* which do not stand in need of this Excitation by fire, as *Musk* and *Civet*, do not so soon consume, but continue their scent for a long time, without any sensible diminution; because the agitation of their particles is very moderate, and consequently but a few of them are dispersed or lost in the *Air*.

CHAP. XVI.

Of the Diseases and Death of Plants.

I. Forasmuch as Contraries discover each others Nature, and that *Life* and *Death* are Contraries, it will not be difficult to find out why Plants do perish; and what the Cause is, why they cease to be nourished, to grow and increase; and to express it in one word, why they die. For

seeing that the *Alimentary Juice* is the immediate Principle of *Motion* in Plants, and that their *Life* doth consist in the due distribution thereof by *Heat*; it evidently follows, that the death or perishing of Plants must consist in the defect of this *Alimentary distribution*.

But because this Defect may proceed from many Causes, we will first speak of the *Distempers* to which they are subject, and shew how many several ways their *Vital functions* may be perverted. For besides the undue disposition of their Parts; as when the Top of them is too much bended down towards the *Earth*; when they are full of knots, and when the distribution of their *Aliment* is interrupted by callous Bumps; when their parts are separated; or when they exceed, or are defective: I say, besides these, there are many other ways whereby they may be brought to their end; as by an undue *Temperature*, when they are either choaked with too much *Moisture*, or consumed by too much *Heat*; when they are shut up and grow stiff, by extreme *Cold*; or wither and pine away, by too much *Drought*. The Ancients reckon up those *Distempers* of Plants, which are described as followeth.

The Disease called *Rubigo*, or *Mildew*, in *Pulse* and *Corn*, is caused by a *Dewy Moisture*, which falling upon them, and continuing there, for want of sufficient *Heat* of the *Sun* to draw it up, doth by its biting sharpness, or Acrimony, scorch and corrupt the inmost substance of the Seed. This Disease also seizeth *Vines*; but may easily be prevented by cutting them later in the year; for the late pruning of them, makes them to flower so much the later, which generally prevents this Evil, because it seldom happens towards the latter end of the *Spring*. Moist and Dewy places are most subject to this Damage; as *Vallies* and shut up places, where the *Winds* have not their free Course; *High ground* being not subject to it.

Roration; which is a distemper of kin to that of *Mildew*, is, when by too much *Rain* or *Dew*, *Vines* are blasted in their flowering, and bring forth only small and dwindling *Grapes*. And after the same manner other Plants are also spoiled, whilst they are yet young and tender, and not sufficiently rooted.

Uredo, happens either when the *Sun* with too great heat scorseth the *Leaves* and *Clusters* of *Grapes*, before that the *Rainy* or *Dewy Moisture* is shak'd off from them; or when *Rain* or *Snow*, lying upon the *Tendrils* or *Buds* of the *Vine*, is by *Cold* congealed to *Ice*.

Carbunculation, is the blasting of the new sprouted *Buds* of the *Vine*, in the *Spring* time; because then the *Vines* are in danger to be smitten, either by the excessive *Heat* or *Cold*. For by too much *Heat*, the Texture of the strings of fibres of the *Vine* become so dissolved, as that thereby the Native disposition of the pores becomes wholly changed; and again by *Cold* it is so compressed, that the pores thereby are shut up, and leave no passage for the *Alimentary Juice*.

Vermiculation is nothig else, but the Infestation of Plants by *Worms*; which Evil is very incident to *Apple-trees*, *Pear-trees*, and *Fig-trees*. For as *Men*, and other *Animals*, are subject to breed *Worms*, so Plants are obnoxious to the same distemper.

II. How many several ways Death may happen to Plants.

III. The effect of Rubigo or Mildew, upon Pulse and Corn.

IV. What Roration is.

V. Uredo.

VI. Carbunculation.

VII. Vermiculation.

per, especially such as bear sweet Fruits, for such as bear bitter or sharp Fruits (excepting only the Olive-tree) are never troubled therewith. The manner of these Insects infesting Plants is declared to us by MALPIGHIUS; It is yet more wonderful, saith he, that commonly, by means of one or two Eggs of a Flie left upon the Leaf of a Vine, Oak, or other like, the whole Leaf becomes drawn together like a Purse about the said Egg, and so withers; yea such is the strange force of one of these Eggs, that not only the Leaf on which it is laid, suffers thus, but the infection being communicated to the Stalk of the Leaf, and from thence to the sprig that sticks to it, and the Leaves that are on it, the whole Branch is twisted and writhed together, and so withers and dies.

VIII.
Defluvium.

Defluvium, is a distemper whereby Trees, in the Spring-time especially, lose their Barks, by reason of some sharp humour, that dissolves the Glew whereby the Bark was fastned to the Wood, whereupon they wither and die, being deprived of their Barks; except this Decortication be not round, but long-wise only, for then it is no prejudice to the Plants, unless it be very great indeed, especially in Resiniferous-trees whilst they are budding. This Distemper also proceeds sometimes from too much Drought, which young and tender Trees not being able to bear, they do easily shed their Leaves and Fruit.

IX.
A Wound.

A deep wound made in any Tree kills it, except the Firr, Pine and the Turpentine-tree, which delight in being wounded, and by this means become fruitful, whereas they were Barren before: for they abounding with a Fat and Clammy Humour, do void part of it by the wound, and thus being unladen of some of their superabundant moisture, are afterwards better nourished, and advance more in growth.

X.
How Plants
Perish by a
Natural
Death.

Plants, as Animals, perish two several ways, viz. by a Natural or Violent Death. Plants die naturally when Aliment is no longer transmitted to them from the Root; or when the Heat, that drives it upwards, and distributes it into all parts, vanisheth. For Heat, as is before mentioned, is the Principle of all motion in Plants, and therefore when that ceaseth, all the Functions of Germination and Nutrition must needs cease with it.

XI.
How many
ways
Plants may
die: a violent
or Death.

Plants, may divers ways die violently; as first by a wound received; whereby we are not only to understand Cutting, Slitting, Pulling off the Bark, Boring or Lopping off the Top, but also Bruising, half Breaking, Tearing, &c. For tho' a Plant, whilst it is pluckt up out of the Ground, doth not suffer any wound, yet because the Passages whereby it drew in its Aliment, are stoppt up, the parts that are towards the top must needs wither, and those that are near the Root must be choaked with the too great abundance of it.

XII.
Ex. over-
much Heat.

Plants also perish by too much Heat, when the Earth is parched by the Heat of the Sun, and all the Moisture or Juice dried up. Whence it is that young and tender Plants, do much sooner perish than those that are grown; for by reason of their tenderness the Heat more easily penetrates their Pores and opens them, and so makes way for the Juice to get out. Moreover their Roots being not so deeply fixed in the ground, when their moisture is exhausted, they cannot so readily draw in

more, to restore the Alimential Juice, they have lost.

In like manner Plants perish by great Cold, which is very destructive to them when it is excessive, and especially when it comes after great Rain; for since the particles of Water, that insinuate themselves into the Bladders of Plants, do very much distend them, they can no longer contain themselves within their Bounds, but breaking out beyond them, do spoil the connexion of their parts, whence follows their total destruction. Accordingly we find that Plants by great Cold are parched and scorched, much in the same manner as if they had endured the most scorching Heats of Summer. We might now proceed to the answering of some Queries, as why Trees that are pluckt up by the Roots, and Branches that are lopt off from the Tree, do continue to live for some time, and do not die presently; why Wild Trees are longer liv'd than those that grow in Gardens and Orchards; but having fully spoken to these in the IX. Chapter of my Natural History concerning Plants, I thither refer my Reader.

CHAP. XVII.

Of Animals, or Living Sensitive Creatures.

AS Nature proceeds from simple things, to those that are more compound, and from meaner and viler things to those that are more noble; in like manner having now treated of Plants, that are a meaner kind of Living Creatures, I proceed to Animals, who besides the Life which they have common with Plants, are partakers of a kind of Sense and Motion. For so Animals are usually defined Living Bodies, furnished with variety of Organs, and endued with Sense and Motion. I say, Living Bodies, because they consist of such a contexture of sensible and insensible parts, that they cannot only recover the parts they have lost, but being excited by objects, can agitate themselves by various motions. So that the matter of an Animal are its Parts, or those Bodily Substances, that complete its Body, and are designed for the due performing of several Actions. And the due and becoming Union of these Parts, whereby an Animal, both in respect of his sensible and insensible Parts, viz. Fibres, Nerves, Passages or Conduits Valvules, &c. is so disposed, as to be able duly to exert his several actions, is his Form. What their Sense is, shall be declared anon.

The Life of Animals consists in a due disposition of Parts, and intense Heat, whereby the Alimential Juice is digested, attenuated, changed and agitated. For the Parts of Animals are not so disposed, that the Alimential Humour which is conveyed through them from the lower part, is from thence by an uniform tenor diffused every where, without any sensible heat, as in Plants: for in Animals there is a Part, which contains an enclosed Fire, to which the Alimential Juice being conveyed by the Veins, doth there undergo an effervescence, and then from thence is driven through the Arteries, to moisten and quicken the whole Body; till after having circulated through the whole Body, it return again through the veins out of the Arteries to the same living Fire, there to be heated and recruited a-fresh.

This

XIII.
By ex-
tream cold.

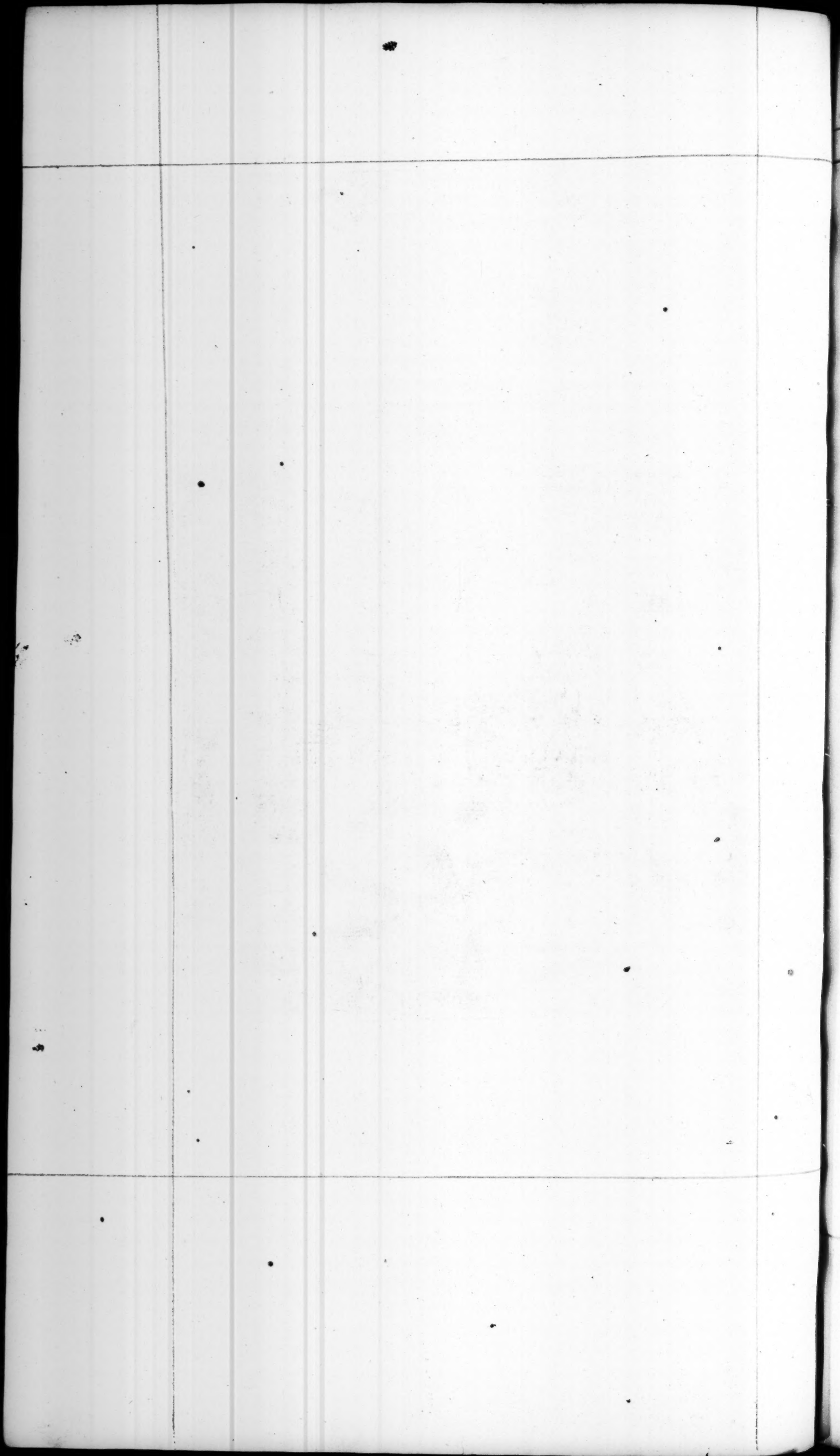
I.
What an
Animal is.

II.
Wherein
the Life of
Animals
doth consist.



G. Freeman del.

J. Kip



III.
What kind
of Heat it
is wherein
the Life of
Animals
doth consist

This Receptacle of *Fire*, in perfect *Animals* is the *Heart*, which is the most hot of all the rest of their *Parts*. Which *Heat* residing in the *Heart*, is called *Natural*, because it doth not presently vanish like to that *heat*, which is found in *inanimate* or *lifeless things*; but is preserved in the coldest *Season*, and as long as the *Life* of *Animals* doth continue. And accordingly it is said to be the first part that *lives*, and the last that *dies* in *Animals*.

IV.
This *Natural*
Heat is
various, ac-
cording to
the differ-
ence of
Age.

Altho' this *Native Heat* do continue till the Death of the *Living Sensitive Creature*, yet it is not always in the same state, for as it encreaseth all the while *Animals* grow up to their perfection, so after that the same is attained, it decreaseth again and grows weaker, till it be wholly extinguishd. At the beginning of *Life*, when the more solid parts of the *Body* are yet soft and tender, they do not so much resist the motion of the *Fluid parts*, as when they are come to their full growth, and so because the *fluid parts* are less forcibly moved, the heat excited by them is so much the weaker also. But in *Old Age*, when the more solid parts of the *Body*, and those more especially through which the *Alimentary Juice* or *Chyle* is strained, in order to the making of *Blood*, begin by degrees to grow harder, and have their pores less crooked and winding, the *native heat* must need thereby be changed and grow weaker.

V.
Wherein
the Power
of Sense
and Motion
that is in
Animals
doth consist.

The Faculty therefore of *Sense* and *Motion* (which by some is called the *Sensitive Soul*) in *Animals* consists in a due disposition of the *Parts*, viz. their *Nerves*, *Muscles*, *Spirits*, *Fibres*, *Joints* and of their other *Organs*; by the help whereof *Animals* become differently affected from outward and inward objects, and are carried from one place to another. For all *Animals* (*Man* only excepted) are a kind of *Watches* or *Clocks*, which by a fit adaptation of their parts, have a *Bodily Principle* of *Motion* in themselves, as long as they are well disposed, and have whatsoever is required to perform and exert the several actions to which they are design'd. For all the Effects we perceive in *Animals* (*Man* excepted) have no other cause or Principle but the *Body*, neither is their *Sensitive Soul* any thing, but the constitution and affection of their *Bodily Organs*; and the *Spirits* or the purest parts of the *Blood*, fitted to the *Animal Life*, and the exercise of the *Senses*.

VI.
What kind
of Fire it is
that is
lodged in
the Hearts
of Animals

And forasmuch as *Heat* is the Principle of all *Motions* in *Animals*, and that whatsoever belongs to *Life* or *Sense* is to be attributed to its continual motion; we must enquire, what this *Fire* in the *Heart* is, and what its Effects are. This *Natural Fire* then, which *Physicians* generally ascribe to the *Blood*, is hot, but without *Light*, and not much unlike to that, which ariseth from the mixture of two *Liquors*, viz. *Oyl* of *Tartar*, and *Oyl* of *Vitriol*. The Reason is, because after that the greatest part of the *Blood*, which hath been rarefied in the *Ventricles* of the *Heart*, is convey'd thence, through the *Arterial Vein* and the *Aorta*, that *Blood* which still remains in the same *Ventricles*, and that which is a-new convey'd into them, from the *Ear-Lappets* of the *Heart*, have the same respect to one another, as the foresaid *Liquors*; the one being instead of a *Ferment* or *Leaven* to the other, to dilate and warm it.

The Cause of the Perpetuity of this *heat* in the *Heart* is, partly because it is closely shut up and pent in there; and partly because this *Fire* is nourished and fed in the *Heart* by the *Blood* of the *Veins*, generated of the *Alimental Juices*, heated by a kind of *Fermentation*, and running into the *Heart*: yet so, as that at the same time this *Fire* doth also in its turn impart a heat to the *Blood*, and thereby preserve the Fluidity and motion of it.

The first effect therefore of this *Fire* is the Dilatation of the *Blood*, contain'd in the ventricles of the *Heart*, together with the warming and attenuating thereof. For it is common to all *Liquors*, that when they are distilled drop by drop into a very hot *Vessel* they presently swell and are dilated. Now the *Blood* being thus rarefied, wants a greater space, and therefore breaks forth from the *Heart*, much in the same manner, as the water resolved into *Vapours*, bursts forth from an *Eolipyle*; and the *Blood* that comes to supply the place of the former, rarefies in like manner as the former, and is extended to a far greater space.

From this successive Ingress and Egress of the *Blood* into and from the *Heart*, not only the *Heart*, but all the *Arteries* together, swell and are depressed; whence follows the Pulse of the *Heart* and *Arteries*, which is as often repeated, as any new *Blood* enters into the *Heart*, and the *Arteries* are extended. For as soon as any part of the *Blood* enters into the hot *Heart*, it presently swells and becomes dilated, by which means it puffs up and distends the *Heart*, and endeavours to get out. Which since it cannot obtain through the same ways by which it entered into the *Heart*, because of the different situation of the *Valves* or *Flood-gates* of the *Heart*, it forceth open the other *Valves* that favours its escape, and so gets out.

And this is the true cause of the *Bloods Motion* throughout the whole *Body*; for seeing that the *Arteries* and *Veins* that are fill'd with it, are continuous, and do not in the least hinder it from continuing its *Motion*, it cannot be otherwise, but that it must alternately, or by turns, with force break forth from the *Heart*, and from thence be driven into the *Arteries* and *Veins*. And it is by this means that the *Blood* derives the *Heat* it hath acquir'd in the *Heart*, to all the other parts of the *Body*. For the more frequent this motion of the *Heart* and *Arteries* is, the more *Heat* we find in our selves, and in so much the less time the *Blood* is carried to the utmost parts of the *Body*.

By this constant Circulation of the *Blood* all the Parts of the *Body* are nourished; because the thinner and purer parts thereof, being separated from the *Excrements*, are added to the parts, taking up the place of some particles which they drive away thence, or also grow and encrease, when greater or more particles of *Blood* come to restore the parts, than can be received into their narrow Pores. And therefore we find, that whilst a *Body* suffers a continual loss of *Blood* it is not nourished, but wastes away, and consumes.

By this perpetual Circulation of the *Blood*, the *Animal Spirits* are also generated, which are the most subtil and swiftly moved particles of the *Blood*, which like a most subtil *Wind*, or rather like a most pure *Flame*, do continually mount up to the *Brain*, fill its Cavities, and from thence through the *Nerves*, penetrate into the *Muscles*,
T t t and

VII.
How this
heat in the
Heart
comes to be
perpetual.

VIII.
The First
effect of the
Fire in the
Heart, is
the Dilata-
tion of the
Blood.

IX.
Whence the
Pulse of the
Heart and
Arteries
doth pro-
ceed.

X.
The Blood
is carried
throughout
the whole
Body of the
Animal.

XI.
The contin-
ual motion
of the
Blood is
the Cause
of the Ani-
mals
growth.

XII.
By the same
motion the
Animal
Spirits are
generated

C H A P. XVIII.

What the Souls of Brute Beasts are.

and impart *motion* to all the *Members*. For we need not to seek for any other *Cause*, that makes those parts of the *Blood*, of which the *Spirits* are generated, to mount up towards the *Brain*, rather than to betake themselves elsewhere; but this, because all the *Blood* that proceeds from the *Heart*, doth by a *Right line* tend that way. And forasmuch as in the *Brain* there is not room enough to contain them all, and the *passages* they are to go through are very narrow, the more *subtil* only of them get through, whilst those that are weaker and less agitated, are diffused throughout all the other parts of the *Body*. And therefore we see, that the *Heads* of many *Animals* do move after that they are separated from their *Bodies*, open their *Eyes*, and bite the *Earth*, tho' indeed they be destitute of *Life*.

XIII.
How the
Animal
differs from
the Vital
Spirits.

The difference between the *Animal* and *Vital* *Spirits* is very small, or to speak properly none at all. For the *Animal Spirit* is nothing else, but the *Vital* better depurated, and freed from its grosser *Particles in the Brain*. Yet they are distinguish'd in this, that the *Vital Spirit*, being diffused with the *Blood* throughout the whole *Body*, doth promote and execute the *Vital Functions*, viz. *Nutrition*, *Accretion*, and *Generation*: Whereas the *Animal Spirits*, collected in the *Brain*, and from thence diffused through the *Nerves* into the *Organs*, are chiefly subservient to the *Animal Functions*, viz. *Sense* and *Motion*.

XIV.
Why the
Animal
Spirits are
unequally
distributed
through the
Body.

But here it may be demanded, why these *Animal Spirits*, do not always flow alike from the *Brain* into the *Muscles*; but are very unequally distributed, so as that frequently many more *Spirits* are sent to some *Muscles*, than to others?

I answer, That this proceeds chiefly from two *Causes*: The *First* is, the unequal agitation and figure of those *Spirits*, and the *Parts* that compose them. Which inequality may proceed from the various Dispositions of the *Heart*, *Stomach*, *Spleen*, and all other parts, which contribute any thing towards their *Production*. Or from the different matters of which the *Spirits* consist; as may be seen in those that have drunk a great deal of *Wine*; that the *Vapours* of the *Wine* swiftly entering the *Blood*, mount up from the *Heart* to the *Brain*, where they become turned into *Spirits*; which being stronger, and in more abundance than those that commonly are there, may be able to agitate the *Body* in many various and wonderful manners. The other Cause is the *Variety* of those *Motions*, which are excited in the *Organs* of the *Senses* by their *Objects*. For it may be easily conceiv'd, that the figure and peculiar agitation of the *Parts*, which constitute the *Spirits*; or the *Action* of *Objects* upon the *Organs* of the *Senses*; or the *Inclination* of the *Animal* to this or the other *Motion*, determining the *Spirits* to enter into this *Nerve* rather, than into another, cause the *Spirit* to run into one *Muscle*, rather than into another: For such is the make or structure of the *Muscles*, that they swell upon the entering in of the *Spirits*, and consequently are contracted, and so by drawing those parts of the *Body* to which they are fastned, effect the motion of them.

A *Brute Beast* is by the *Peripateticks* commonly defined to be an *Irrational Animal*, or an *Animal endued with Sense*. Yea, they make them almost *Rational*, as supposing that some plain Foot-steps of *Reason* are observable in *Beasts*. But we on the contrary are persuaded, that a *Beast* is a meer *Automaton* or *Engin*; that is, an *Animal* destitute of all *Knowledge*, and consequently may be thus defined: A *Beast* is an *Artificial Engin* or *Machin* of *GOD*, furnish'd with a various and wonderful structure of *Organs*, containing in it self a material Principle of *Life*, *Motion* and *Sense*. For herein *Beasts* do differ from *Men*, that these have an *Immaterial* or *Intellectual Substance* joyned to *Matter*; which the former have not.

It cannot be deny'd, that there are some *Actions* in *Brutes*, which have a great resemblance with those that are in *Men*; whence some have concluded, that they had the use of *Reason*, tho' in an inferior degree, in comparison of *Men*. How comes it to pass, say they, that when a *Dog* in hunting comes to a place where 3 Ways meet, having laid his *Nose* to 2 of them, he immediately casts himself along the third? How can it be conceiv'd, that *Birds* should be able to build their *Nests*, with such extraordinary *Artifice* and convenience for themselves and their young, if they be wholly destitute of *Discourse* and *Reason*? These and other *Actions* of *Animals*, have racked the *Brains* of several, and forced them to allow some foot-steps of *Reason* to *brute Beasts*. But this *Question* will be easily determin'd, by supposing 2 things.

First, That no *brute Animals*, how perfect soever they be, can express their *Thoughts* (if they have any) by *Words*: Which yet all *Men*, how dull and stupid soever they be, can do; neither are any of them so far distracted, but that they can discover their *Affections* by *Words*. The *Reason* of which difference doth not proceed from the *Organs*, seeing that several *Animals*, such as *Parrots* and *Jackdaws*, utter *Articulate words*, and yet for all that can never attain to our way of *Speaking*, that is, they can never manifest to others, that they understand what they pronounce. Whereas on the contrary, persons that are born *Deaf*, and to whom Nature hath deny'd the use of *Speaking*, can by *signs* discover their Conceptions to others, and make known what they desire or refuse, by their *Gesture*, *Eyes*, and the like. Now the want of this in *Brutes*, doth not only argue a less degree of *Reason* in them, but also strongly prove them to have none at all.

In the *Second place*, we must suppose that the *Signs* which have been invented by *Men* to represent their *Conceptions*, do differ very much from those *Natural Voices* and *Signs*, which are genuine Expressions of *Bodily Affections*. Wherefore seeing the former are not to be found in *Beasts*, and that they are not able any way to express their *Minds*; neither must we allow them to have any use of *Reason*.

If any one will say, That *Beasts* do discourse and talk together; this they must prove before we can believe them: For seeing they have *Organs*

I.
The Defi-
nition of a
Brute Beast.

II.
What hath
persuaded
some, that
Beasts make
use of
Reason.

III.
Brutes can-
not express
their own
Thoughts.

IV.
There are
no signs
taken up
as plain
to be found
in Brutes.

V.
Whether
Beasts do
Discourse
together.

gans that are much like ours, why should they not be able to communicate their *Thoughts* to us, as well as to one another? And tho' in some cases they act with extraordinary *industry* and exactness; yet cannot we from thence infer, their acting according to *Reason*, for otherwise they would excel in many things; but only this, that Nature works in them according to the disposition of *Organs*: In like manner as a well-wrought *Watch*, doth more certainly and exactly distinguish the *Hours*, than we possibly could do with all our *Study* and *Endeavour*.

I conclude therefore, that there is no *Soul* in *Brutes*, besides the Disposition of their *Organs*, and the figure of their *Bodies*; and that all their *motions* depend only on the Influence of their *Spirits*, and the due Disposition of their *Organs*. Neither will this seem strange, if we consider, that even all our *Actions*, which we perform, *without minding or giving heed to them*, are produc'd by the same Cause, as *Respiration*, the *Motion of our Heart*, the *Digestion of our Meat*, and the like. For all these do not appear in the least different from those that are done by *Engins*. This is evident from one Instance, viz. that those who fall from on high, stretch forth their *Hands* to save their *Heads*, which they do without any assistance of the *Soul*; but only because the structure of our *Body* is such, that the sight of an imminent Fall, being convey'd to the *Brain*, drives the *Animal Spirits* into those *Nerves*, that move the *Arms and Hands*: Seeing all this is done without the least advertence in the *Soul*. And thus we see the Reason, why a *Sheep* flees at the sight of a *Wolf*, even because the Light reflected from the *Body* of a *Wolf*, doth so agitate the *strings* of the *Sheep's Optick Nerves*, and consequently the *Brain*, that thereby the *Animal Spirits* are so driven into the *Nerves*, as to put the *Members* destinated for running into motion.

This *Doctrin* may be confirmed from several places of *Scripture*, which plainly asserts, that the *Soul of Beasts* is their *Blood*; *Levit. 17. 14. For the Life, or Soul, of all flesh, is the Blood of it. Gen. 9. 4. But Flesh with the Soul thereof, which is the Blood thereof, shall ye not eat. Deut. 12. 23. Only be sure that thou eat not the Blood, for the Blood is the Soul.* From whence we may evidently conclude, That the *Life of Animals* consists in the continual flowing of the *Blood* and *Vital Spirits* to the *Brain*, and other parts of the *Body*. And therefore, that we need not search for any other Cause of those *motions* we find in *Beasts*, but the *Influence of Spirits*, and the *Disposition of their Organs*.

As to that Objection, That *Dogs*, after they have laid their *Noses* to two Ways, without any further hesitation, betake themselves to the *Third*; we say, that this is not done by them from any *Reasoning*, but only because in that third Way they meet with the *Scent of the Beast*, which they did not find in the two other. Neither doth the building of *Nests* argue any force of Reason to be in *Birds*; because all the *Nests* that are built by *Birds* of the same kind, are all of them built after one and the same manner, which would not be so, in case they acted according to the dictates of *Reason*: For we find that Men who act so, build their *Houses* with the greatest variety, according

to the different Suggestions of their Rational Faculty.

Neither do we altogether deny *Life* to brute *Beasts*, but freely allow them such an one; the Activity whereof proceeds from the disposition and structure of their *Bodies*. Nor *Sense* neither, if it be only taken for a *Bodily Affection* of the *Members*, outwardly and inwardly fitly disposed and aptly joyned, to perform this or the other motion. We grant also, that *Beasts* do many *Actions* by Nature, like to those which *Men* perform of Choice and deliberately; but withal assert, that the various and sudden motions of *Beasts*, do not argue them to have a *Knowing Soul*, but only a most curious and exactly proportionate compofure of *Parts*, so as that the least thing is sufficient to put it in motion: And that this is possible, we prove by that *Wooden Statue of Venus*, which was so Artificially made by *Dædalus*, that it could walk up and down: And by the *Wooden Dove*, made by *Archytas* of *Tarentum*, which did fly about in the *Air*.

You'll say, that *Apes* do many things that manifestly prove them to have the use of *Reason*; as appears in that when they go out to fight, they observe exact Military Order, and range their *Armies* as *Men* do; as also, in that they bury their dead, and perform many other such like *Actions*, which demonstrate them to be, in some degree, *Reasonable Creatures*.

To this I Answer, That all these *Actions* are performed by *Monkeys* naturally. For as *Watches* point the *Hours*, so *Beasts* perform their *Actions* by Instinct: Neither is it a matter of greater wonder, that *Monkeys* do marshal their *Armies*, supposing it to be true what *Historians* relate of them, or bury their *Dead*; than that *Dogs* and *Cats*, after they have voided their *Excrements*, scrape up the *Earth* round about, to cover them from the Eyes of *Men*; tho' indeed they seldom do it to any purpose; that is to say, so as to hide them wholly. Whence it is evident, that they act merely by Instinct, and without any advertency of what they do; and that there is nothing more in them, than there is in any curious *Clock-work* or *Machin*.

Conclude we therefore, that *Beasts* perform all their *Actions*, whether *Sensitive* or *Motive*, only by the Texture and Disposition of their *Parts*, without any thing of *Thinking*, tho' in the most imperfect degree imaginable. For if we allow *Brutes* to be endued with *Understanding*, be it never so mean and imperfect, then we cannot deny them the Privilege of a *Soul*; and so shall be forc'd to own, that *Monkeys*, *Dogs*, *Foxes*, &c. have *Souls*, as well as *Men*: And if we grant this, we must also allow, that this *Soul* is *Spiritual* and *Immortal*; because *Thinking*, wherein the Essence of the *Soul* consists, is not a Mode of the *Body*, neither doth in the least depend on it.

Moreover, supposing the *Souls* of *Beasts* to be *Spiritual* and *Indivisible*, it will follow that they are also *Immortal*: Neither is there any Argument drawn from the *Light of Reason*, whereby we can prove the *Immortality* of *Human Souls*, which will not as well prove the same concerning the *Souls* of *Beasts*. Besides, if we allow *Knowledge* to *Brutes*, we must also make them capable of *Religion*; for to imagin a *Knowing* or *Thinking Creature*.

IX.
How Life and Sense may be allowed to Beasts.

X.
Whether Apes are to be accounted Rational Creatures.

XI.
If Brutes have a Soul, it must be Immortal.

XII.
If Brutes have Souls, they will not be distinguish'd from Men.

VI.
The Soul of Brutes consists in the Disposition of their Organs.

VII.
This confirmed by several places of Scripture.

VIII.
How Dogs light upon the true Trace of the Hare.

Creature, without being under an Obligation to obey GOD, and pay Religious Duties to him, is repugnant. For if the Souls of Beasts be *Knowing*, they will in the first place know themselves; and it is impossible, but that by knowing themselves they should be led to the knowledge of their Creator. Which Opinions would pave a ready way to *Atheism*.

This Question is discuss'd more at large in my Dissertation, of the want of Sense and Knowledge in Brutes; to which the Reader may have recourse.

CHAP. XIX.

Of Fourfooted Beasts and Reptils, or Creeping things.

I.
The Division of an Animal into Rational and Irrational, is no true Division.

AN Animal is commonly divided, in the Schools, into Rational and Irrational, as into two Members that take in the whole Nature of Animal, and comprehend all its several species. But since ARISTOTLE himself doth not approve of this Division, because one of the Terms of it is a Privation of the other; for he declares, that all Divisions so express'd are illegitimate; none will think strange if we reject it for the same Reason. For the word Irrational, or Unreasonable, represents no positive Idea, which yet is requisite to constitute the difference of several species or kinds. Besides, every Division must be express'd in such terms, as do explain and lay open the Natures of the things divided; whereas by Negative terms, neither any Attributes nor Properties are declared; and consequently the Division of Animal into Rational and Irrational, is to be rejected, and to be reckon'd amongst those which are good for nothing else, but to render the Nature of things dark and obscure.

II.
Of Animals, some are Terrestrial, some Volatile, and others Aquatile.

III.
What a Terrestrial Animal is.

An Animal therefore may more commodiously be divided into Terrestrial, Volatile or Flying, and Aquatile or Swimming, from the places where they live, and the motions they exert.

We call those Terrestrial Animals, that live on the surface of the Earth; whereof some be Fourfooted, that go upon four Feet; and others Reptils, which wanting Feet, do move themselves by Creeping. Fourfooted Beasts do go by setting their Feet one before another, after the same manner as other Animals that have 2 Feet, or more than 4. To the performing of which progressive motion are generally required Toes, Feet, Shin-bones, Legs, which together with the Nerves, Muscles, Tendons, Ligaments, Gristles and Membranes, constitute the Organs of Progressive motion. The Bones belonging to this Organ are in several places joyned by Articulation, the round Head of the one being lodg'd in the Hollow of the other. The Toes consist of many Joints, to which the Instep is joyned, and to that the Heel, and the Bone call'd Navicularis or Cyboïdes; the Leg is joyned by articulation with the Ankle, and the Thigh with the Hip-bone, and the Shank or Leg. Progressive motion therefore is performed, when one of the Legs standing still upon the ground, the other is thrust out forwards: For the Legs are not moved both together, but by turns; so that whilst Animals go forwards, the Muscles act their several Parts, and the Thigh is turned in

the Hip-bone, and the Ankle about the Leg.

Whence it follows, that a Man, for Example, cannot walk directly in a Right line; because as he goes, he rests himself sometimes on one Leg, and sometimes on another, so that both his Legs or Feet are not moved in a Right line, but according to 2 Parallel lines, which seem to be Right lines. It follows also, that a Man that goes or walks, doth continually rest or stay himself upon the Earth; because one of his Feet doth always stand firm on the Earth, till the other comes to take its turn: Whence it follows, that it is only the Foot that stands still, that makes the Bulk or Trunk of the Body to move forwards. It follows also, that the advancing Foot moves as fast again, as the Trunk of the Body: For seeing that the Body advanceth continually, and that the Feet advance only by turns, one half of the time must be allow'd for the Resting, and the other for the Advancing; and that consequently the Foot that advanceth, by moving as fast again, doth compensate the delay of its resting.

Amongst Fourfooted Beasts, some are greater; as the Horse, Elephant, Camel, &c. Some of a mean Bigness; as the Dog, Lion, Sheep, Cat, &c. Some Little; as the Rat, Mouse, &c. And of these, some are Viviparous, that bring forth living Births; and others, Oviparous, that lay Eggs.

Those are Viviparous, that bring forth a living and perfect Animal; and Oviparous are those that lay Eggs, whence an Animal afterwards is hatched: Such as are the Crocodile, the Lizard, Frogs, Tortoises, whether of the Land or Sea. It is matter of Wonder, that the Crocodile, so vast a Creature, which commonly grows to the length of 15 Cubits, should proceed from an Egg no bigger than that of a Goose. Lizards, whether those of the greater sort, that are green, or those other that are distinguish'd with shining Stars, are propagated by Eggs. The Tortoise of the Earth, lays Eggs with a Yolk in them, which it covers with Earth, and by the warmth thereof are hatched; whereas the Sea-Tortoise covers hers with the Sand of the Sea-shoar. Serpents also are Oviparous, and commonly lay their Eggs in Horfe-dung, or near to the heat of an Oven or Furnace, because they cannot hatch them themselves, as Birds do.

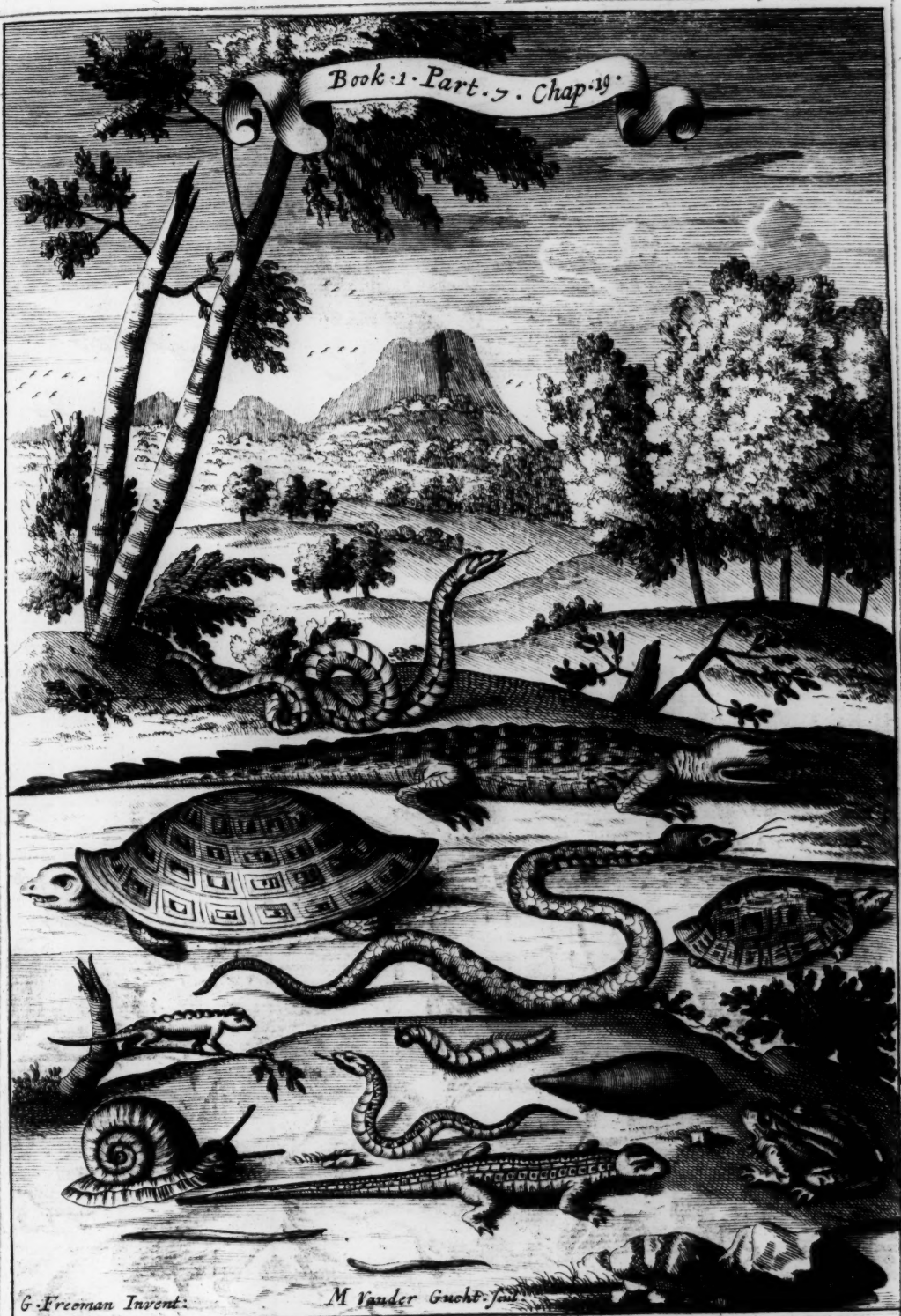
Amongst Reptils, or Creeping Animals, are the Viper or Adder, the Asp, and the Snake: All which resting upon one part of their Bodies, shoot forth and advance with the other. Yet all Reptils do not perform their Progressive motion after the same manner: For Snakes creep by raising their Bodies into Rings, the former whereof advance, whilst the hinder rest, and support the motion of the other: For by the first of these Rings the Body is extended; and by the hinder, they contract themselves in more close Rings, and as it were gather up themselves. Earth-worms also creep by a Waving motion, that is, by contracting and unfolding themselves; so that whilst one part of their Body rests, the other is moved. To this way of Creeping may also be referr'd that of Snails, who by means of their glutinous Moisture, are fixed to the Bodies they creep upon, and by this means advance themselves. The Cause of all these Motions are the Animal Spirits, which being forceably

IV.
Circumstances attending the Progress of a Man.

V.
Of Fourfooted Beasts, some are Viviparous, and others Oviparous.

VI.
What Animals are Viviparous, and what Oviparous.

VII.
How Reptils move forwards.





To the Worshipfull
of Norton = Conyers
of Yorkshire Esq^r.
Wife, daughter, and
Thweng of Kilton
in the Said County
This Plate is humbly



Chichester Graham
in the North Rideing
And to Anne his
Heyress of Thomas
Castle in Cleaveland
Esq^r. deceased

Dedicated by Richard Blome.

forceably, and in great abundance, driven into the Channels of the *Nerves* and their *Valves*; and not being able to go back, by reason of the make of those *Valves*, by distending the *Nerves* in breadth, and shortning them in length, do move that part, to which they are joyned, by way of traction or drawing.

C H A P. XX.

Of Flying Animals, or Birds.

I.
What Birds
are, and
why the
Eagle is
said to be
the King
of Birds.

Flying Animals are commonly called *Birds* or *Fowl*; and are distinguish'd from others, for that they fly in the *Air*. The *Eagle* is accounted to be the *King* of them, because of the Strength of his *Body*, the Height of his *Flight*, the Sharpness of his *Sight*, and the Nobleness or Generosity of his *Temper*.

II.
The various
kinds of
Birds.

There are innumerable Kinds of *Birds*; and forasmuch as it is next to impossible to speak of all the *Individuals* of them, I shall content my self to enumerate their *Principal kinds*, as they are distinguish'd according to their several ways of *Feeding*. Some are *Carnivorous*, or such as feed upon *Flesh*, commonly called *Ravenous*: And these again are of two kinds, viz. such as have *Crooked Bills*; as the *Eagle*, the several sorts of *Hawks*, &c. Others have a more strait and sharp-pointed *Bill* or *Beak*; as the *Raven*, the *Jack-Daw*, *Mag-Pye*, *Crow* or *Rook*, &c. Another kind are *Vermivorous*, or such as feed upon *Worms*; as the *Nightingal*, *Wood-Cock*, *Snipe*, *Wood-pecker*, *Titmouse*, *Wren*, &c. Another *Baccivorous*, or such as feed upon *Berries*; as are the *Thrush*, *Black-bird*, the *Starling*, &c. Others are *Granivorous*, that feed upon *Co'n* and other *Seeds*: And of these again, some love to be scraping and tumbling in the *Dust*; as *Cocks* and *Hens*, the *Peacock*, remarkable for his beautiful *Tail*, the *Bustard* and *Partridge*. Others love to wash and dip themselves in *Water*; as amongst *Singing-Birds*; the *Linnnet*, the *Ligury*, the *Lark*, &c.

III.
All Birds
go upon
two Feet
only.

Birds have only two *Feet*, and those either plain and flat; as *Swans*, *Ducks*, *Geese*, and all *Water-Fowl*: Or else have their *Claws* sever'd and divided; as *Eagles*, *Sparrows*, *Swallows*, *Pigeons*, &c. Some Report, that the *Manucodiatæ*, or *Bird of Paradise*, hath no *Feet*, but always hovers in the *Air*, and is never found upon the *Earth*, but when dead: But Reason and Experience evince the falshood of this Story. For all *Animals* stand in need of *Sleep*, which these cannot take in the *Air*, especially being always in a hovering motion.

IV.
That the
Bird of
Paradise
hath Feet.

And as to those who imagin, that the *Birds of Paradise* take their Rest hovering in the *Air*, by reason of the Lightness of their *Body*, and the Largeness of their *Wings* and *Feathers*, and never fall down to the ground till they be dead; I would fain know of these Men, why they do not fall down to the ground when they are *asleep*, as well as when they are *dead*; forasmuch as in *Sleep* all the *Senses* are lock'd up, and all *motions* of the *Members* cease? But that all Doubt may be taken away in this Point, let us consult such as have been Eye-witnesses. ANTONY PIGAFESTA, a Famous Traveller, in the *Diary* of his Naviga-

tion assures us, that they have *Legs* of a Hand-breadth long, and that they can go and fly like other *Birds*: And that none but *Strangers* suppose them to be *without Feet*; because the *Inhabitants*, whenever they take them, cut off their *Feet*, and take out their *Guts*, casting them away, and then expose them to the *Sun* to dry, which they then sell to *Strangers*, or stick them in their *Caps* or *Helmets*, for *Ornaments* sake.

Birds are the Product of *Prolifick Eggs*, that is, such as have been invigorated by the *Male*, and presuppose the fruitfulness of the *Female*. For as an *Egg* without the *Cock's Treading* is *addle*; so the *Hen*, by producing that Cavity which is in the *Yolk*, doth contribute likewise to the fruitfulness thereof. This will be the better understood by distinguishing the *Egg* into 2 Parts, viz. into the *Yolk* and *White*. The *Yolk* is of a yellow Colour, tending to *Red*, as being nourished by *Blood*; which is manifest from those *small Veins*, that are dispers'd throughout its outward Coat or *Membran*. Besides this *Coat*, there is also another very thin one, by means whereof the *Yolk* hangs to the *Cluster*, so called, and covers the whole *Yolk*, and conveys *Veins* and other *Vessels* to it, by means whereof the *Alimentary Juice* is transmitted. The *White* is the more Outside-part of the *Egg*, yielding copious Nourishment, but somewhat of a colder Temperament, and not so easie of digestion as the *Yolk*: It consists of a *fibrous* or *stringy Matter*, and therefore is easily coagulated, growing hard with the least *heat*. At the Broad-end of the *Egg* a little *Hollow* is found, where the *Chicken* begins to be formed; and this proceeds from the *Hen* only. Besides these, there are found in *Eggs* 2 *Specks*, call'd by us the *Cock's Threadles*, in which the *plastick* or formative Virtue of the *Egg* is supposed to consist, according to the Opinion of the Common People; but it is a Mistake, seeing they are found in all *Eggs*, as well in those that are *addle*, as the *prolifick*. An *Egg* therefore becomes fruitful, when the *Seed of the Cock* is joyned to that *Hollow* or *Scar* in the *Egg* before-mention'd, which proceeds from the *Hen*. For it is not to be question'd, but that the *Seed of the Cock* doth reach the *Womb* of the *Hen*, and as it were, takes root in the *Cells* thereof; whence the Rudiment of the *Chicken* afterwards buds forth.

When the *Hen* therefore sits upon the *Egg*, and excites the *Bud*, or *prolifick* part of it by its *heat*, the *strings* or *fibres* become dilated or extended into several concentrical Rounds or Circles, and the *Chicken* becomes formed by degrees. For the second day of the *Hens* sitting, the *Hollow* that is at the broad end of the *Egg*, begins to be dilated, and becomes a *Bubble*, the thinner *particles* of it being exhaled by *Heat*, those only remaining that constitute that most clear water, wherewith the *Bubble* is filled. On the *Fourth* day a Purple Spot, or Reddish point appears, which is the Rudiment and first beginning of the *Heart*, and from whence a short time afterwards proceed many little *Veins* of the same colour, but almost invifible by reason of their fineness and subtilty, and which afterwards end in the *Umbilicary* or *Navel Vessels*. On the *Fifth* day there appear in this Rudiment of the *Heart*, 2 *Ventricles*, and as many *Ear-lappets*; and because the *Ventricle* or *Right Cavity* is con-

V.
Birds pro-
ceed from
Eggs.

VI.
The Pro-
gress of
the Form-
ing of a
Chick, the
1, 2, 3, 4,
and 5th
Day.

U u u

tracted,

tracted, when the *Ear-lapper* that is joined to it is dilated, they seem to be 2 *Bladders*. The same day, there appears something in the likeness of a *Worm*, joined to the little *Vein*, to which the round little *Body* is annexed, but bigger than it, being distinguished into 4 *Bubbles* filled with a most clear and *Crystalline Liquor*. Which 4 *Bubbles* do represent both the *Eyes*, the *Brain*, and the *Cerebellum* or hinder part of the *Brain*.

VII.
What is
formed in
the Chick
the succeed-
ing days.

On the *Sixth day* the *Feet* and *Wings* of the *Chicken* are formed, the *Coats* and *Membrans* of the *Eye* begin to appear, as likewise the first beginnings of the *Lungs* and *Liver*. Also the *Bill* or *Beak* and all the *Guts* and *Inwards*. At the same time the *Chicken* begins to move it self a little, and to lift up its *Head*. Then also the *Rudiments* of the *Bones* begin to be formed, appearing like so many thin *Spider Webs*. On the *Seventh day* all the parts begin to appear more distinct, and so encreasing every day till the *Tenth*, wherein all its parts are compleated. For the *Head* then appears greater than all the rest of the *Body*; and the *Eyes* bigger than the *Head*; and in this state the *Chicken* swims on the *Colliquamentum* or dissolved *White* of the *Egg*. After the *Fourteenth day*, all its members appear still more distinctly: for then it begins to be covered with *Feathers*, the inwards begin to be hid, and the *hinder part* of the *Brain* begins to be pent up in the *Skull*; the *Chicken* begins to *Peep* or *Cheep*, and being no longer able to bear the straightness of his pent up *Room*, after having first consum'd the *White*, and afterwards the *Yolk* also, it breaks through the *Shell* and comes forth.

VIII.
It is proba-
ble that a
Chick and
other Ani-
mals, are
not formed
by Parts,
but all to-
gether.

This is the Progress our *Eyes* discover in the forming of a *Chicken*, because it appears such to the unassisted *Eye*. But when we take in the Verdict of the *Microscope*, as *MALPIGHIUS* did, there will appear to us in every *Fruitful* or *Prolifick Egg* (for in the *Addle*, no such thing is to be found) before the *Incubation* of the *Hen*, the first *Rudiments* of the *Chicken*; in like manner as sometimes, even without the assistance of a *Microscope*, we can discern the first *Lineaments* of a *Plant* in the *Bud* of it. This is very evident in a *Tulip*, for if in the *Winter* time we view the *Bud* of it, either with a *Magnifying Glass*, or only with our bare *Eye*, we shall not only see the *Leaves*, which afterwards turn *Green*, but also those that constitute the *Flower* of the *Tulip*, with the *Triangular* part of it enclosed in the *Grain*, and last of all those little 6 *Pillars*, which surround it, at the bottom of the *Tulip*. And accordingly it seems probable, that as a *Flower* contains a *Flower*, so an *Animal* contains another whole and compleat *Animal*, tho' sometimes the same be not discoverable, but with the assistance of a *Microscope*.

IX.
How Birds
do fly in
the Air by
the Help of
their Wings

Birds with the help of their *Wings*, keep themselves up, and move in the *Air*; because the *Air* resists the swift agitation of their *Wings*, and opposeth their descent or falling down. For tho' the *Air* be very pliable, and ready to give way to other *Bodies*, yet it indeed makes a great resistance, and like the *Water*, opposeth the entrance even of *Heavy Things*. For we see that when *Boyes* skim *Stones* along the surface of a smooth *River* or *Pond*, the *Water* resists them, and makes them by several rebounds leap up from the *Water* which opposeth their entrance. Yea many times

the *Bullets* discharged from great *Guns* are seen to graze along, and rebound from the *Water*, so that sometimes men that are walking on the *Bank* or *Shoar* are sometimes wounded and killed, by *Bullets* so rebounding from the *Water*. And in the same manner are *Birds* borne up in the *Air*, and tho' they be heavier than it, yet by the spreading and continual beating of their *Wings*, they are supported in the midst of it.

To the flying of *Birds* 2 things are requisite, First the spreading of their *Feathers*, the single *Hairs* whereof are so intangled, that the *Air* cannot enter through them without some difficulty, from whence the resistance ariseth. Secondly, the expansion of their *Wings*, and their beating of the *Air* with them, and that either leisurely, as *Kites* do, or more frequently like *Doves*, or very fast as the *Felcare*. And accordingly by the Prevalence of this resistance, the force of Gravity is overcome, and the *Body* of the *Bird* continues poised in the *Air*.

Moreover forasmuch as *Birds* do not only press the *Air*, and hover in it, but also move up and down; it is necessary that the *Wings* which bear them up, be thrust backwards; that so by the resistance of the *Air* behind them, they may be forwarded in their progressive Motion. For the structure of a *Birds Wings* is such, that the hollowness of them forward, and their prominence backward, do both concur to beat back the *Air*. A Resemblance whereof we meet with in those that swim, who if they do only press the *Water*, with their *Belly* and *Hands*, without beating it back with their *Feet*, they cannot move forwards; no more than a *Ship* can advance if the *Water* be only divided by the *Oars*, without they be thrust or moved backwards. *Birds* therefore in order to their moving forwards, and passing this way and that way, must beat back the *Air* behind them. And whereas some *Birds* fly much more swiftly and strongly than others, as the *Swallow*, the *Pigeon* and the long-winged *Hawks*; the reason thereof is, either the more advantageous make and frame of their *Wings*, or the strength of their *Muscles* wherewith they move them, or the proportion of *Heaviness* or force that is in their *Bodies*.

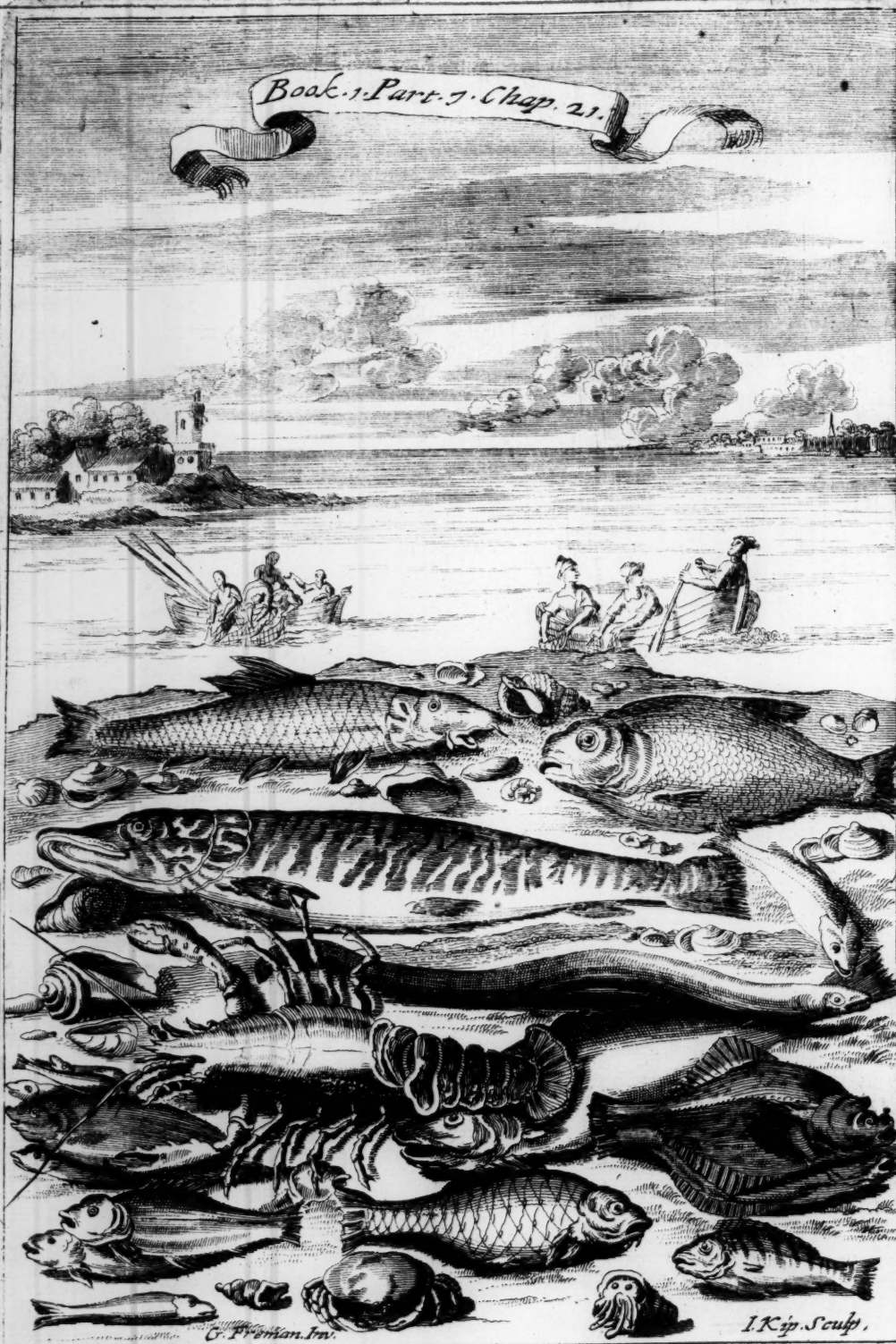
We must take notice that *Birds* do not move in the *Air* like a *Ship* or *Boat* in the *Water*. For a *Boat* or *Barge* being driven by *Oars* is pushed forwards, whilst the *Oars* thrust against the *Water*, which resists, in a manner, as much as if all its parts were in rest. Neither do *Birds* shake their *Wings* towards their *Tails*, as *Oars* drive the *Water* towards the *Stern*, but do bend them downwards. The *Tail* of *Birds* serves to incline their flight upwards and downwards, but not side-ways, neither is it to them instead of a *Helm*, as is commonly believed; for it doth not perpendicularly cut the *Air*, as the *Helm* of a *Ship* doth the *Water*, but hath an *Horizontal Situation*; and when a *Bird* turns side-ways yet his *Tail* continues straight stretched out; and therefore we see that *Birds* fly tho' their *Tails* be cut off. *Birds* therefore are poised in the midst of the *Air*, as a *Ship* in the *Water*, to wit in the Center of their Gravity. And like as a *Vessel* that hath his *Oars* more swiftly plied on the right side, turns about the Center of its Gravity towards the left: So likewise a *Bird* whilst he beats the *Air*, chiefly and mostly

X.
Two things
are requi-
red to the
Flight in
Birds.

XI.
How Birds
move them-
selves this
way and
that way.

XII.
Birds are
not moved
in the Air,
as a Ship
in the Wa-
ter.

Book. 1. Part. 7. Chap. 21.



G. Freeman. Inv.

J. Kip. Sculp.

mostly with his Right *Wing* towards the *Tail*, his fore-part by this means is turned towards the Left. As when those who swim, by bending their Right Arm, and spreading their Right Hand, drive the *Water* towards their Feet; and by the same means turn themselves about towards the Left-hand.

XIII.
The Tail of
Birds only
moves up-
wards and
down-
wards.

Figure
60.

And that we may the better apprehend how the Tail of Birds serves them to turn downwards or upwards: Let us suppose a Bird A B, whose Center of Gravity is C, flying horizontally from G to F, and that in flying he rear his Tail B H; this supposed, it is manifest, that the Air, which resists the Tail B H, makes the whole Body of the Bird turn about the Point C, that it may take the situation L K, wherein the Head raiseth it self from A to L; and on the contrary, when the Tail is turned downwards to B I, the resisting Air makes the Body of the Bird to turn about the same Point C, for to take the posture N O, wherein the Head of the Bird doth lower it self from A to O.

CHAP. XXI.

Of Swimming Animals, or Fishes.

I.
The Whale
is the great-
est of all
Fishes.

Fishes, because they live in the Water, and move themselves by way of Swimming, are called *Aquatiles*. The most bulky of these, and as it were the Prince of them all, is the *Whale*, very common in the *Indian Sea*, to whom *PLINY* assigns the largeness of 4 Acres, which make out in length 960 Foot. *PARÆUS* makes mention of one that was taken in the River *Schelde*, 10 Miles from *Antwerp*, in the Year 1577, which was 58 Foot long, 16 Foot high, and its Tail 14 Foot broad; the distance from his Eye, to the entrance of his Mouth, 16 Foot; his Under-Jaw was of 6 Foot furnish'd with 25 Teeth, to which in the Upper-Jaw were answering so many Cavities, wherein, upon the shutting of his Jaws, they were hid. A *Whale* is distinguish'd from other Fishes, in that it hath, besides Lungs, Kidneys, Arteries, Bladder and Genitals, a great Pipe in the fore-part of its Head instead of Gills, by which with great force it spouts again out the Water it receives into its Body.

II.
The Difference
of
Fishes with
respect to
the several
places they
delight in,
and their
coverings.

There be many differences of Fishes taken from the coverings of their Bodies, or from the Place they delight in. With regard to the Place some are Sea-fish, others River-fish, and others such as delight in Lakes and Ponds. With respect to their covering, some are Scaly, some covered only with a Skin, and that either with a smooth, or rough one. Amongst Sea-fish some are called *Littoral*, because they delight in the neighbourhood of the Shoar, such are amongst the Scaly Fishes the Roach, and the Trout, &c. and of the smooth skin'd Fishes, the Mackrel and the Eel; others are called in Latin *Saxatiles*, because they delight in Stony Places, as the Gilt-head, common in the Sea of Crete, the Gudgeon, the Hornback, some pass from the Sea into Rivers, as the Salmon, the Lamprey, &c.

III.
Fishes are
propagated
by Copula-
tion.

Some have been of the opinion that Fishes were not generated by Copulation, but that the Female swimming before did scatter her Spawn, which the Male following her did impregnate, by pouring his Milt upon them. But this is a mistake,

for Fishes do copulate, which would be altogether in vain, in case the foresaid opinion were true. Besides how can we conceive that the Spawn or Eggs of the Female Fishes, should be sprinkled with the Milt of the Males, seeing that it would by mixing with the water lose all its virtue. Neither can we build much upon *ARISTOTLES* Authority in this Case, forasmuch as he doth not prove it by any Experiments. And in his 3d Book de Animal. Cap. 7. he owns the thing to be doubtful. Fishes therefore are generated by Copulation as all other Oviparous Animals are: but to what purpose would this Copulation be, if the Male doth not by his Emission render the Eggs of the Female fruitful? Besides, it is observed that the Males abound with Milt at the same time that the Females abound with Spawn or Eggs, and that then is the time of their Copulation. And it is at the same time that the Males follow the Females, not that they may besprinkle the scattered Eggs, but that by their repeated Copulation, they may impregnate other of the Females Eggs that are ready to be Spawn'd: as we see that to the same end a Cock doth often tread the Hen: for seeing that Fishes, above other Animals, do abound in Eggs, they can never all of them be impregnated by one act of Copulation. From this way of Generation we are to except the Dolphin and the Whale, which are not Oviparous, but bring forth living Births, and therefore their way of Copulation is different, and their Breasts are filled with Milk, contrary to the nature of other Fishes.

Amongst Fishes there be many that are called *Monstrous*, as the Hippopotamus or the River Horse, because it resembles a Horse, yet not so much in Figure, as in its Bulk. For it hath Ears like a Bear, and a Mouth wider than that of a Lion, with very great Eyes, and a very short Neck, or none at all; it hath the Tail of a Swine, with short Feet, and a divided Hoof like a Hog. *ARISTOTLE* describes this Animal Lib. 2. Hist. Animal. thus; The River-horse, saith he, which Egypt brings forth, hath the Mane of a Horse, a round Hoof like a Pipe or Tube, a flat Snout, and an Ankle like those that divide the Hoof in two, Teeth somewhat prominent and sticking out, the Tail of a Swine, the Voice of a Horse, the bigness or bulk of an Ass; the thickness of his Hide being such, that they make Hunting-staffs of it; and all the inward parts of it resembling those of an Ass or Horse; which is the account *PLINY* gives us from *Aristotle*. The Sea-calf is also accounted a Sea-monster, for it differs from all other Fishes in the shape of its Body, inasmuch that *ARISTOTLE* ranks it amongst 4 footed Beasts. This Monster hath short Arms, without any Elbow; and for the rest hath some resemblance with our Bodies: It consists of many Bones, and is covered with a thick Hide, full of dark coloured Hairs, drawing towards an Ash-colour: the Head of it is but little with respect to its Body, and its Neck is long, which it can stretch out, and draw in at its pleasure; it hath no Ears, but instead thereof only some open bores; its lower Jaw resembles that of a Wolf, but the upper is much broader than those of the same Animal; his Nostrils are very like that of a Calf, his Teeth like those of a Wolf, and his Eyes are of a changeable and uncertain colour. A Thornback also is a very deformed

IV.
Many Mon-
sters are
found a-
mongst
Fishes.

and

and monstrous *Fish*, but being so commonly known, there is no need to insist upon the Description thereof.

V.
The Peripateticks following their Master, deny all Respiration to Fishes.

Forasmuch as *Respiration* is ordained by Nature for the Cooling of the *Blood*, and to send away the vapours and smutty steams proceeding from the *Body*, which would otherwise stop the *Blood* from entering into the left *Ventricle* of the *Heart*, if they were not emitted out; it hath been a question controverted amongst the *Antients*, whether *Fishes* and other *Animals* that want *Lungs* do breathe or no. This is commonly denied by the *Perepateticks* upon their *Masters* Authority, who by no means will allow any *Respiration* in *Fishes*.

VI.
Fishes breathe by the drawing in, and letting out of their Breath.

But our Modern *Philosophers* and *Physicians*, tho' they cannot allow *Fishes* such a *Respiration* as is performed by the Contraction and Dilatation of the *Midriff*, and *Lungs*, since they take for granted that *Fishes* (except *Whales* and *Dolphins*) have no *Lungs*, yet neither do they deny them such a *Respiration* as consists in the drawing in of *Air* or the like *Halituous Matter*, in order to the cooling of their *Blood*. *Pliny* joins with this opinion, *Lib. 9. Cap. 7.* because, saith he, instead of *Lungs* they have other *Organs* for *Breathing*, and instead of *Blood* some other *Equivalent* humour. Neither do we want reason wherewith to back this opinion; for the end of *Respiration* is the cooling of the *Heart*, and the cherishing and refreshing of the *Vital Spirits*: now both of these are necessary to the preservation of the Life of *Fishes*. Besides, why were *Gills* given to *Fishes*, but that through them the *Water*, either alone by it self, or mingled with the *Air*, might be conveyed to the *Heart*, and afterwards cast out again? But who will not be convinced that *Fishes* must take in the *Air* by *Respiration*, when we find that they die without it? For if *Fishes* be shut up in a *Vessel* with a narrow *Mouth*, full of *Water*, they may be kept alive there for many *Months*, if the mouth of it be kept open, but if it be shut up they die immediately, which would never be if they did not stand in need of *Air*, or if *Water* alone were sufficient for the cooling of their *Heart*.

VII.
The Respiration of Fishes proved by Experiment.

And what is very observable herein, is that as soon as the *Vessel* is stoppt the *Fish* get themselves up to the top of the *Water*, to take in some *Air*, which they do not do whilst the *Vessel* is open, but play up and down the *Vessel*. Wherefore *RON-DELETIUS* in his 4th. Book of *Fishes*, *Cap. 9.* saith, that the greatest *Fishes*, and those that have *Lungs* do draw in the *Air* together with the *Water*; and cast it out again by the same *Pipe*, whereby they draw in their *Breath*: and in this manner do *Whales*, *Dolphins* and *Whirlpools* (a *Fish* so called) draw their *Breath*. Others perform this *Respiration* by the *Lungs*, only without the assistance of a *Pipe* to cast out the *Water*, as *Sea Tortises* or *Tortles*, and those of *Rivers* and *Lakes*; as also *Sea-Calves*, who have wide *Nostrils*, and a very strait *Windpipe*, by which means they spout out the *Water* again through their *Nostrils*, but retain the *Air*. All other *Fishes* that have either open or closed *Gills*, do with them draw in the *Air*, and at the same time cast out the *Water*. *Oysters* which are covered only with a very thin *Skin*, seem to breathe through the *Pores* thereof. And in a Word, all *Animals* living in the *Waters*, according as their *heat* is more intense or

remiss, or according as their *Spirits* are more or less copious, so they have a several way of *Respiration*.

Neither indeed is there any *Animal* in the Universe, which is not preserved by the *Air*, as is manifest from the *Pneumatick Engine* of Mr. *BOYL*, in which whatsoever *Animals* are put, excepting only *Oysters* and *Crabs*, die immediately. The same thing is yet more evident in *Insects*, in whose *Rings* & *Holes* are discernible; which when they are stoppt with *Oil* or any other *glewy* or *clammy Liquor*, so that the *Air* cannot have its free entrance, the *Animal* presently begins to languish, and after some *Convulsive* Motions expires.

But you will object with *ARISTOTLE*, that if the *Air* do penetrate the *Water*, and reacheth to the very heart of *Fishes*; why then for the same reason a *Man* may not as well fetch his *Breath* under *Water*?

I Answer, that the cause thereof is, because *Man* living in the *Air*, doth continually attract it very copiously, whereas that portion of *Air* which is in the *Pores* of the *Water*, is very inconsiderable if compared with that which *Men* naturally take in, and therefore is not sufficient to answer that end. Moreover, for want of *Air* the *Water* is drawn into the *Lungs*, and there being no way to cast it out, because of other *Water* still coming in, it oppresseth the *Heart*, and choaks a *Man*. Whereas *Fishes* are furnished with *Gills*, by the help whereof they cast out the *Water*, nor suffer it to come to their inwards, but the *Air* only, whereby the heat of their *Heart* is allayed and their *Vital Spirits* preserved.

The *Swimming* of *Fishes*, doth somewhat resemble the *Flying* of *Birds*: for their *Fins* are instead of *Wings*, as also their *Tail*. These consist of *Membranes*, joyned together by long *Fibres*, and which can be distended or contracted and turned every way.

There are in all *Fishes*, *Bladders* full of *Air*, which according as they are compressed or dilated, so the *Fishes* are poised on the *waters*. For it hath been observed that a *Fish*, whose *Airy Bladder* had been broken in the empty *Recipient* of the *Pneumatical Pump*, could never, during a whole *Months* time, that it lived in a *Fish-pond*, rise to the top of the *water*, but was fain to keep at the bottom of it. According therefore as *Fishes* do contract or dilate the said *Bladder*, so they encrease or diminish the bulk of their *Body*, and accordingly also do diminish or increase their *weight*; and by this means they can either dive to the bottom of the *water*, or mount to the top of it. Much after the same manner as *Glass Bubbles*, or *Figures* hanging in a *Glass Tube* full of *water* are made to go down to the bottom, or to come up to the top at pleasure.

A *Fish* by moving of her *Tail* advanceth swiftly, and rests when that motion ceaseth; so that the shaking or turning of her *Tail* is the chief cause of her motion; for when she shoots forwards directly with her *Belly*, she turns the other half of her *Body* sideways, and whilst she strongly beats the *water* with her *Tail*, she at the same time moves her body forward, much after the same manner as a *Boat*, which the *Oar* drives forwards, whilst it obliquely strikes the *water* that is behind it. A *Fishes Tail* also performs the use of a *Helm*, by turning the *Fishes* course to the Right or Left.

Thus

VIII.
The Life of all Animals is preserved by the Air.

IX.
Why a Man cannot breathe under water.

X.
How Fishes swim.

XI.
What instruments the Fishes use to move themselves in swimming.

XII.
What use the Fishes make of their Tails.



To M^r John
and Heyre of Iohn
in Brecknock shire, and
London Esq^s, by



Jeffreys only Son
Jeffreys of Lly well
of the City of
Elizabeth his wife.

This Plate is humbly

Dedicated by Richard Blome.

Figure 61.

Thus by Example, the *Fish* A B C, that is about to move it self, turns its *Tail* D F C, to the Right G, and that so, that whilst the part moved B C, turns about its *Center* B, it doth not continue strait, as the Ray of a *Circle*; but bends it self 2 several ways towards B, viz. by advancing her side F towards the Right-side G, and by turning the utmost part of her *Tail* D to the Left, by which means the *Water* does but little resist her. Afterwards, her *Tail* turning again by the force of the *Muscles*, it drives the *Water* from G towards F, as an *Oar* would do: Whence it follows, that the *Fish* must advance from C to A, and then its *Tail* being again moved from C to H, as we have said that it was moved from F to G; and being afterwards turned again, it drives the *Water* from H towards C, and by this means makes the *Fish* advance in a strait Line from C to A; by the repeating of which motions of her *Tail*, the *Fish* continues swimming along.

XIII. Of Flying Fishes.

Amongst *Fishes* there are some that fly; as the *Sea-Swallow*, and the *Sea-Hawk*, so called, which have fins joyned to their *Gills* of that length, that they reach almost to their *Tails*. These sometimes fly in such vast Shoals in the *Air*, as *PLINY* tells us, that they encumber *Vessels* in their Course, and sometimes make them sink. But they never fly high in the *Air*, but keep close to the Surface of the *Water*; so that some question, whether the *Sea-Hawks* fly or swim. They continue thus hovering in the *Air* as long as their *Fins* are wet; and as soon as they are dry, fall down again into the *Water*.

CHAP. XXII.

Of Insects.

I. Four kinds of Bloodless Animals.

ARISTOTLE reckons up 4 kinds of Bloodless Animals: Such as are soft, as the *Polypus* or *Pourpoutel*, the *Cuttle-fish*, &c. Such as are cover'd with a hard Shell, and difficult to be broken; as the *Crab*, *Lobster*, &c. Such as are cover'd with a Shell that is brittle and easily broken; as *Cockles*, *Perwinkles*, and other small Shell Fishes; and of these there is so great a variety, with respect to figure and colour, that they cannot all of them be reckon'd up. And, Lastly, *Insects*, so called from the Intersections and Divisions of their Bodies; which also are styled by *ALBERTUS MAGNUS*, *Annulata*, as consisting of several Rings.

II. The great variety of Insects, with relation to the place wherein they live.

The Variety of *Insects* is very great, with respect to their Food, the quality of their Bodies, and the Place in which they live. As to the Place, *Hairy* and *Red Worms* are generated in the Snow: *Fire-flies*, which some suppose to be *Crickets*, in the Fire. Which I have spoke of in my *History of Nature*, in the Part that treats of Animals. In the Sea, the *Sea Scolopendra*, and *Water-Flea*: In Fresh-waters, *Leeches*, *Horse-Leeches*, &c. In the Earth, *Earth-Worms*; between the Barks of Trees, *Wood-Lice*; in Fig-trees, a certain Worm called *Cerasses*; in the Service-tree, Red and *Hairy Worms*; in Vines, the Worms called *Butyri*, &c.

III. The difference of Insects, with respect to their Parts.

As to their Parts, some *Insects* have no feet, others have. All *Worms* are without feet, as well those which are generated in the Earth, as *Earth-Worms*; as those that breed in the Bodies of Ani-

mals, especially in their Guts. The *Weevil*, that breeds in Corn, another that is found in Beans, &c. Amongst those that have feet, some have 6; as the *Pismire*, the stinking Bug, the Flea and Louse: Others have 8 feet; as the *Scorpion* and *Spider*: Some 12; as that of *Canker-worms*, which is called the *Geometrician*, because it hath 6 feet in the fore-part of his Body, and as many in the hinder-part, and raiseth up his Back in the form of a Bow or Arch, going like one that measures Land: Some have 14 feet; as all other sort of *Canker-worms*, which in the fore-part of their Bodies have 6 feet, and 8 in the hinder part.

As to the Generation of *Insects*. The general Opinion formerly hath been, that they were not produced by a true Generation, but deriv'd their Pedigree from the Corruption of Animals, or other things. But Experience hath informed us of the contrary: For if we put a piece of *Flesh* into a Bottle, and then stop it; the *Flesh* shut up there will never breed any *Worms*; but if we leave the Bottle unstopt, it will be full of *Worms* in less than 4 days, in the Summer time. We find also, that *Butter-flies*, after Copulation, do lay a vast number Eggs, whence *Canker-worms* are hatched.

IV. Of the Generation of Insects.

So that we may rationally conclude, that all those Animals which seem to breed of themselves, and are found in Cheese, in Fruits, in Trees, in Flowers, and in Men, are the product either of Eggs, or such like Seed, left by other Animals. The production and process of which, may be fully illustrated by the Generation of a *Canker-worm*. For *Canker-worms*, as all other *Worms*, are generated from a Seed, or from the Eggs of Flies or *Butter-flies*, which by the heat of the Sun are hatched into *Worms*; which, after they have changed their Skins several times, turn to *Canker-worms*, and then to *Aurelia's* or Bodies without motion, cover'd with a Shell, and in which no distinction of Parts appears; and these again are turned into *Butter-flies*, or *Flies*. For it sometimes happens, that from the same *Canker-worms* and *Worms*, *Aurelia's* do proceed; whereof some are turned into many *Flies*, and others into single *Butter-flies*. Out of a *Worm* therefore a *Canker-worm* is formed; because, as a Plant doth not immediately bring forth branches, flowers, leaves and fruit, but by degrees, and each of these in their due Season; so these *Worms*, by degrees, arrive to a further measure of perfection. For certain it is, that these *Worms* do often change their Skins. A *Canker-worm* therefore is changed into an *Aurelia*; because the Trunk of its Body being swoln, and its Members almost formed, it so happens that all his Coats and Coverings begin to grow dry, and fall away of themselves; as Flowers fall from Trees, and Feathers from Birds; which when the *Aurelia* perceives, it either wraps it self in a Leaf, or with a glutinous Liquor proceeding out of its own Body, it most artificially weaves a strong Covering for her self; where it continues shut up, as in an Egg, till it receive new Members, Head and Wings, and so become turned to a *Butter-fly*.

V. All Insects proceed from Eggs.

And the same is to be said of all other *Insects*, that have Wings. For *Flies* proceeding from Eggs or Seeds, by some Changes as have now been mentioned, do attain to the Perfection of their Nature; for first they are *Worms*, then they turn to *Aurelia's*, and out of them *Flies* do proceed.

VI. Flies and other Insects, proceed from Worms.

X x x

ceed. For as a *Canker-worm* is to a *Butter-fly*, the same respect or relation a *Worm* hath to a *Fly*. And so likewise *Lice*, *Fleas*, *Bugs*, and other such like *Insects*, are generated of *Eggs* or *Nits*, or of other *Insects* already produced. For all those *Animals* which are commonly said to be generated out of *putrid Matter*, that is the Corruption of other things, are produced by *Copulation*; as we see that *Flies* do *Copulate* when *August* is past, and thereupon they bring forth not *Worms*, but *Eggs*, which are found in great abundance upon the *Leaves of Trees*, in the appearance of a *black smutty Matter*; which afterwards, by the *Heat of the Sun* are hatched into *Worms*, but such as are immoveable, and answering to the *Aurelia's* of the *Canker-worms*, which afterwards are changed into *Flies*.

VII.
How Canker-Worms become changed into Butter-flies.

This *Metamorphosis* is not so difficult to conceive, if we suppose that those Parts which seem to be produc'd anew, are only made visible, as having before been hid. For when *Canker-worms*, by Example, become *Butter-flies*, it is easie to conceive, that the *wings* and *feet* they get, and which makes them appear to have been changed into new kinds of *Things*, are not newly produc'd Parts, by obtaining of a new *form*, which they had not before; but that these Parts were indeed before, and only wanted a sufficient *Magnitude* to render them *visible*. After the same manner as it happens to *Plants*, where the *flowers* and *fruits* do not unfold themselves, but by degrees, and some time after the *Leaves*; tho' all these Parts be at once actually together in the *Plant*, before they appear to be there. *Insects* therefore, as well as other *Animals*, are generated by the Coition of *Male* and *Female*; which latter lays *Eggs*, out of which afterwards their *Young* are hatched by the *heat of the Sun*.

VIII.
How the Eggs of Insects are preserved in the Winter Season.

But here it may be demanded, How these *Eggs*, whence we have said that *Canker-worms* and *Flies* are hatched, are preserved all the *Winter* over, so as that the next *Year* they may produce *Animals*. *ALDROVANDUS*, in his Treatise *De Insectis*, supposeth that those *Eggs* only are preserved, which are in those *Leaves* that are hid in the *Cavities* of the *Barks of Trees*, where they cannot suffer any damage from the *Injuries of the Air or Weather*. Thus I my self, saith he, have observed *Eggs* fastned to the hinder part of *Fig-Leaves*, whence, towards the End of *August*, little *Canker-worms* did proceed. They were wrapt up in a thin *Downy substance*, to preserve them from being hurt by the *Ambient body*; which *Canker-worms* afterwards falling down, were not dash'd against the *Ground*, but continued hanging in the *Air*, like *Spiders*, by a very fine *Tbread*. When they lay their *Eggs* on the Under-side of *Leaves*, they do so fold the said *Leaves* that no *Rain* can hurt them, making as it were a *Covert* over them. I have also twice taken notice, that a *Canker-worm*, which I found amongst *Cabbage-Leaves*, did first lay *yellow Eggs*, wrapt up in a thin *Downy matter*; which, after she had laid them, became changed into an *Aurelia* of the same Colour, as she had before when yet a *Canker-worm*, viz. *yellow, green and black*; and, which seem'd strange to me, afterwards *flying Animals* proceeded from these *Eggs*, so very small, that they could scarcely be discerned by the *Eye*; such as

are commonly found in the *Bladders* that are on the *Leaves of the Elm-tree*. So far be. Tho' there be some *Country-men* that tell us, That these *Eggs* are not only kept between the *Barks of Trees*, but that many *Leaves* fill'd with the *Eggs of Butter-flies*, are many times found hid in the *Earth*, where they are preserved all the *Winter*, till by the *heat of the Sun*, at the return of *Spring*, they be hatched into *Insects*.

CHAP. XXIII.

Of the Death and Destruction of Animals.

AS in the *First Chapter of this Part* we reduc'd the *Notion of Life* to 3 Heads; so here, that we may understand how *Animals* may be said either to *dye* or *perish*, 3 sorts of death or dying are to be distinguish'd. First, There is a *Death of Simple Annihilation*, which is oppos'd to the *Life of Simple Existence*: Secondly, *Cessation from Operation*, which is the *Death* that is oppos'd to the *Life of Actuous Existence*: And, Lastly, the *Separation, or Dissolution of one part from the other*, which is oppos'd to the *Life of Existence with another*. By the first manner of *Death*, those things *dye*, which by ceasing to exist altogether, fall into nothing: Things *dye* the second kind of *Death*, when they cease to act: And the third way, when their *Parts* are separated, and exist distinctly from one another. But forasmuch as no *Substance* can be annihilated, it remains only for us to enquire, how *Animals* come to cease from all *Operation*, and how the connection of their *Parts* comes to be dissolved.

But before I come to Treat of these, I shall first lay down this Truth, That *Death* is as much the intention and design of *Nature*, as *Life* is. For who will say, that *Corruption* is less Natural, than *Generation*? For tho' nothing seems to *dye* without reluctance, and some force put upon it; yet is not *Corruption* therefore to be accounted less Natural or disagreeing with the *Laws of Nature*. For tho' *Corruption* be contrary to particular *Nature*, as procuring its *Destruction*; yet is it very consentaneous to *Universal Nature*, which never undertakes the *Generation* of any thing, without the fore-going *Corruption* of another, as not being able to create, or to produce a thing out of *Nothing*. Wherefore seeing, that the *Beauty and Perfection of the World* consists in *Variety*; and that it is much more for the *Dignity of the World*, that many things in process of time should appear and act their *Parts* on this great *Theatre*, than to represent always one and the same *Face* of things: The *Divine Wisdom* hath so order'd it, that *Old things* should make way for *New ones*; and that those things, which for some time have acted their *Parts* on the *Stage of the World*, should withdraw to make room for others. But if any one shall think it a hard case for him to leave this *World*, let him consider, that he himself could never have enter'd this *World*, but by others making room for him: For if all our *Ancestors* had been *Immortal*, they would have been increased to that number, that there would have been no place left for their *Posterity*.

Having

I. Of these kinds of Death.

II. The Death and Perishing of Animals is designed by Nature, as well as their Generation.

III.
When and
how Death
happens to
Animals.

Having said thus much to comfort us, and make the state of our *Mortality* more tolerable, we now assert that *Death* happens to *Animals* by the extinguishing of the *Fire*, that is in their *Hearts*. For in the *Hearts* of all *Animals*, as long as they are *alive*, there is a kind of *Continual Heat*, which we before call'd a kind of *Fire* that is *hot* without *shining*, and which *Physicians* do own to be the *Bodily Principle* of all *motion* in the *Members* of *Animals*. And therefore no wonder, if this being once extinct, *Life*, *Sense* and *Motion* be likewise destroyed.

IV.
How this
Heat comes
to be weak-
ned in the
Body of
Animals.

For tho' this *Native Heat* be strong and efficacious at the beginning, yet in the process of *Age* it loseth strength, and grows weaker and weaker; so that *Animals*, after they are come to their full growth, are at a stand, and soon after their strength decays; and at last, by the defect of this *Heat* they *dye*; as the *flame* of a *Wick*, for want of *Oil* is extinguish'd. But yet there is a difference betwixt the *flame* of a *Lamp*, and the *Life* of *Animals*; because the former is continued, as long as it is supplied with *Oil*: But the *Life* of *Animals* cannot be maintained by perpetual *Aliment*, because *Animals* *dye* not for want of *Aliment*; but because their *Heat* grows so weak, that it can no longer change the *Food* into the Substance of the *Body*. And therefore *Physicians* tell us, that the *Heat* which Nature hath afforded us, for the Maintenance and Support of our *Bodies*, doth conspire their destruction. For tho' it preserves us, forasmuch as by feeding upon *Moisture*, it affords strength and vigour to our *Members*; yet at the same time it also lays the foundation of our Destruction, whilst by continual consuming of our *Moisture* it self becomes debilitated, without restoring, as much as it doth consume: And accordingly it follows, that when the *Moisture* is consumed, the *Body* must consume and waste likewise, and the *Heat* it self be extinguish'd.

V.
Why the
warmest
parts of
the Body
first grow
cold in
those that
are ready
to dye.

Now that *Death* proceeds from the decay of *Heat*, daily Experience teacheth us in Dying persons: For we find that the Extream parts of their *Body* first begins to grow cold, till at last their *Breast* and *Heart* it self be deprived of it. For since the *Heat* which is disperst through the whole *Body*, proceeds from the *Arteries*, inasmuch as by thinning the *Blood* that is in them, it generates those *Spirits* which communicate *Motion* to all the Parts of *Man's* *Body*; it must of necessity follow, that when the *motion* of the *Arteries* and *Heart* grows weak and languishing, this Weakness must first affect the *Capillary Veins*, as being both small and weak, and at the greatest distance from the *Heart*, the Fountain of *Heat*.

VI.
An Obje-
ction from
the motion
of Animals
after their
Heart is
taken out
their Bo-
dies.

It may be you will Object here, That some *Animals*, after that their *Heart* hath been taken out of their *Bodies*, have notwithstanding performed the functions of *Life*. ARISTOTLE alledgeth the Example of a *Tortoise*, which when his *Heart* is taken out, doth nevertheless walk about, though he be but small, and of a weak and slow *Body*. Some *Historians* also make mention of some persons, who have spoke after that their *Heart* hath been pluck'd out of their *Bodies*. Now, whence could these *Actions* or *Words* proceed, if the *Heart*, by its beat, were the sole *Principle* of all *Bodily motion*, and if it were the first thing living, and the last that *dies*?

To which I Answer, That the *Actions* performed by *Animals*, after they are deprived of their *Heart*, are to be attributed to an *Influence* derived from thence; inasmuch as by the *Arterial Blood* convey'd to the *Brain*, the *Spirits* for a short time continue their begun *motion*, and by entering the *Nerves*, produce a *motion* in the *Tongue*, or other Parts of the *Body*. Thus we find that *Insects*, after they have been cut to pieces, do for a long while continue their *motion*, by reason of the strength and vigour of their *Animal Spirits*, which cannot so soon exhale out of the *Joints* of that Expansion, which is in them instead of a *Back-bone*, and wherein the said *Spirits* are contained. And as to that which was added, that the *Heart* is the first thing that *lives*, it is to be noted, that this is not to be understood of the time in which the *Birth* *lives*, shut up in the *Mothers Womb*; but after it is come forth from the same. For it is manifest, that the *Birth* in the *Womb*, doth not so much live by a *Life* of its own, as by that of its *Mother*; and that its *Arteries* do not beat from the *motion* of its own *Heart*, but by that of its *Mother*. Wherefore tho' the *Heart* be not the *Principle* of all *motions*, that are performed in the *Body* before the *Birth*; yet is it the *Principle* of all those that are exerted afterwards.

VII.
The Cause
of this
Motion.

The *Natural Heat* therefore last forsakes the *Heart*, whether in a *Natural* or *Violent Death*: For being the chief *Principle* of all *Corporal motions*, it is more strong and vigorous there, as in its Fountain, and makes the greatest Resistance against any Force put upon it. Thus one that hath been *Drowned*, if he be timely taken out of the *Water*, and laid with his *Head* hanging downwards, that by the voiding of the *Water* out of his *Mouth*, his *Midriff* may no longer be clogg'd by the distension of his *Stomack* from the great quantity of *Water* he hath taken down, and that by this means his *Breast* and *Wind-pipe*, being freed from that which stopt and oppress'd them, be restor'd to their former freedom, the Person returns to life again; because there was still some Force remaining in the *Heart*, whereby it was able to recommence its former pulsation. In like manner, a Person that is starved with *Cold*, being timely restor'd to warmth, Recovers again; because the *Vapours*, that were congealed in his *Breast*, begin to be dissolved and discomb'd by the inward *Heat*, which was not yet wholly extinct, being assisted by the outward.

VIII.
By what
means Men
that have
been drown-
ed, are re-
stored to
Life.

Wherefore this is the only difference that is between a *Natural* and a *Violent Death*; as by *Hanging*, *Beheading*, &c. that a *Violent Death* is performed in a moment, or a very short time: Whereas a *Natural Death* comes on by degrees, and by slow advances, dissolves the *Tye* that is between the Parts: But in both of them, the *Heat* and *Fire* in the *Heart* is alike extinguish'd, and takes its flight into the *Aethereal Air*, as the *Ancients* were wont to express it. Accordingly SENECA, in his 66th *Epistle*, saith; *The Death of all Persons is alike; tho' the ways by which it makes its approaches be different, yet it ends and terminates in one and the same thing. No Death is more or less than other; for it hath one and the same measure and manner in all, that is, the termination or putting an end to Life.*

IX.
The differ-
ence be-
tween a
Natural
and a *vi-
olent Death*.

The

The Eighth Part

OF THE INSTITUTION OF PHILOSOPHY. OF MAN, CONSIDER'D WITH Relation to his Body.

CHAP. I.

The Definition of MAN.

I.
The wonder-
ful Composi-
tion and
Structure
of Man.

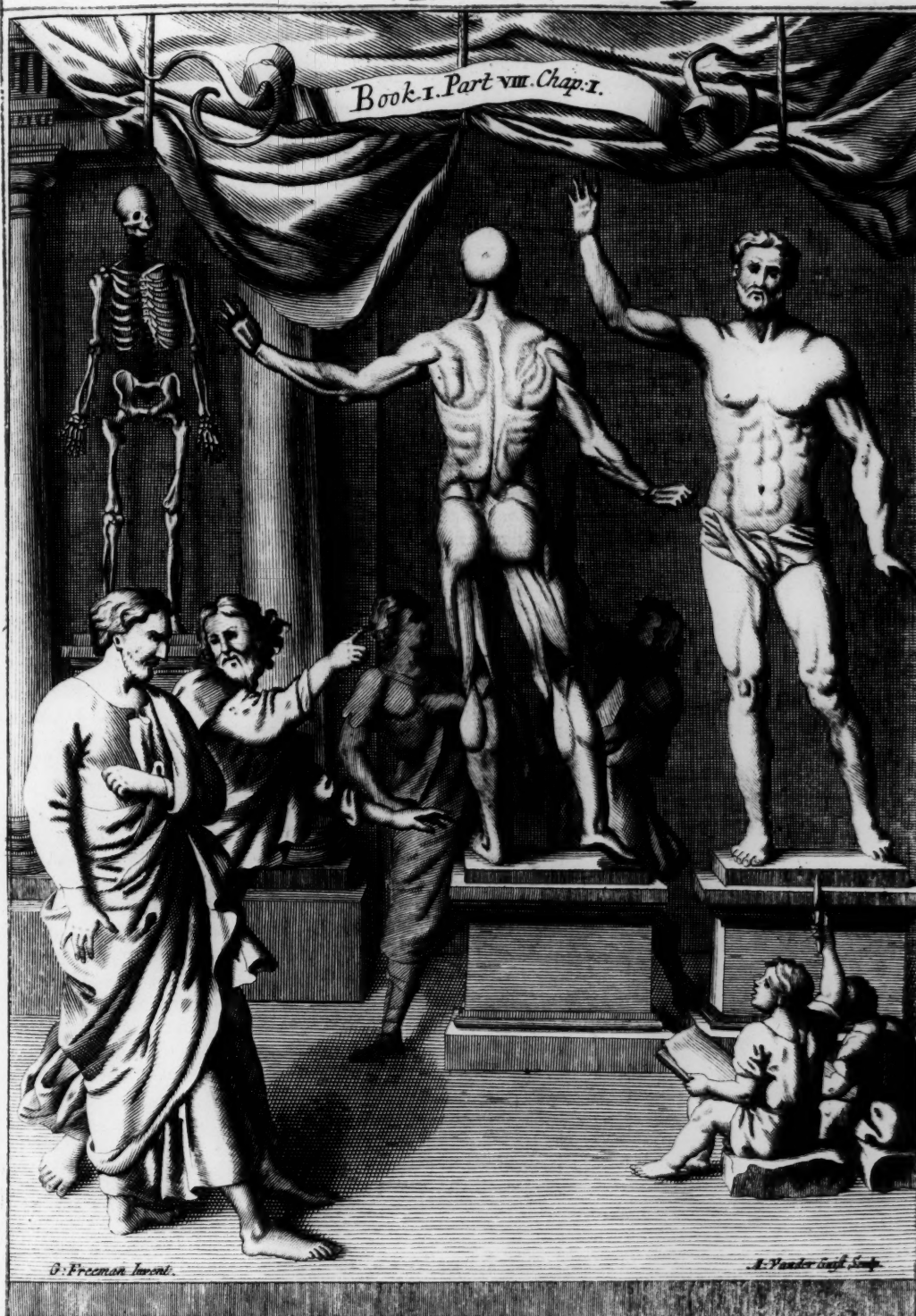
WE are now come to MAN, the most Noble of all *Living Creatures*, besides whom the *Philosophers* do not esteem any thing Great that is in the *World*; as containing in himself, whatsoever is in the *Universe*; and therefore is commonly call'd, the *Compendium* or *Abridgment* of the whole *World*, and the most *Wonderful* of all *Wonderful things*, as PLATO styles him. It admits a Query, Whether he may not be look'd upon as a *Prodigy* amongst all other *Living Creatures*, as consisting of such different *Parts*; and more especially for the great Disparity that is between the *Soul* and his *Body*: So that it would scarcely be a greater Wonder, if an *Angel* should be joyned to a *Beast* or *Light* make an Alliance with *Darkness*. And therefore FICINUS, upon *Plato Dialog. 1. de Legibus* speaks thus: *And because he had said, that this one Animal was composed of such different things, he not without reason subjoyns, that Man is a Miracle or Wonder amongst all other Animals; herein imitating Mercurius Trismegistus, who calls Man, a Great Wonder, &c. But, to pass by the rest, why is Man such a Wonder? Because forasmuch as he is Divine, it is a wonder that he should be affected with Mortal things; and being Mortal, it is as great a wonder, that he should be taken with Divine things.*

Wherefore it hath always been look'd upon by *Philosophers*, to be a difficult thing to define *Man* aright, and to assign those *Terms* that might explain the Connexion of such different things, and exhibit a clear *Image* or *Idea* of him to the *Understanding*. The PERIPATETICKS, who conceit themselves to know the Nature of all Things, define MAN to be a *Rational Animal*, making *Animal* the *Genus* of *Man*, and *Rational* his *Difference*; whereby he is distinguish'd from other *Animals*. But to speak the Truth, this doth not seem to be the true *Definition* of *Man*, if we will give heed to the Rules of a *Right Definition*; the chief whereof is this, that it be *Clear* and *Evident*. Now it is manifest, that the word *Animal*, which they thrust into the *Definition* of *Man*, is obscure, and therefore cannot in the least contribute to the clear perception of him. For it is not manifest what the word *Animal* (which they make the nearest *Genus*) doth signify, without reducing it to the more remote *Genera* of a *Body*, a *Living* and an *Animated Creature*: But now, the higher we climb in the *Prædicamental Table*, the more obscure Notions we shall meet with; and therefore if the *Prædicats* of *Animal* be obscure, how will they be proper to explain and illustrate the Nature of *Man*?

Again, if we carefully examine what *Man*, and what an *Animal* is, we shall find, after a due balancing of the Notion of them both, that we do more easily understand what *Man* is, than what an *Animal* is; and that we have a more clear Conception of *Man*, than of an *Animal*. Neither

II.
Whether
or no the
Peripate-
ticks do
rightly
define Man.

III.
The word
Animal,
cannot be
an Ingre-
dient of
the defini-
on of Man.
can



To Ralph Macro of Clapton in the
 Parish of Hackney in the County of
 Middlesex, D.^r in Phisick. *~~~~~*
 This Plate is humbly Dedicated by Rich: Blome.



[Faint, illegible handwritten text, possibly a signature or a note.]

can any one mend this matter, by saying that an *Animal* is that which is endued with *Life and Sense*, since the notion of *Life and Sense* are every whit as obscure, yea more difficult to conceive. Wherefore seeing no *Definition* is to be admitted that is more obscure than the thing *defined*, and that this *Definition* of a *Reasonable Animal* doth not afford any sufficient light for the understanding of the *Nature of Man*, the same is to be rejected, and to be left in its own darkness.

Besides, the word *Reasonable*, which is the other part of the *Definition*, or the *Difference*, is ambiguous; for by it must be either understood, that which is endued with *knowledge*; and then the *Difference* will agree and coincide with the *Genus*, forasmuch as according to the *PERIPATETICKS* some *Brutes*, at least, are endued with *Knowledge*, and are not meer *Engines* as we take them to be. Or else by the word *Reasonable* is to be understood *Discourse, Knowledge*, as most of them hold, and so the difference of *Man* will be taken from an inferior *Attribute*; forasmuch as *Man* the further he attains to perfection, the less he makes use of *Ratiocination* or discursive *knowledge*; and *Wise-men*, who are nearer to the nature of *Angels*, do more understand things without *Discourse*, than others do. Or lastly it imports a *simple apprehension*, whereby things are conceived, without any Relation or Reference to others, which since they allow to *Beasts* also, they will never be able to explain, what kind of *knowledge* it is they attribute to them, and how it is distinguishable from that which is peculiar to *Man*.

This *Definition* also is contrary to other *Laws* of a true and Rightful *Definition*, in as much as it doth not perfectly unfold the *Nature of Man*. For seeing *Man* is compounded of 2 Parts extremely different, viz. of a *Soul* and a *Body*, and that there is not the like conjunction of parts to be met with again in the whole *Universe* of things, it appears very plain that the *Essence of Man* cannot be exactly defined, except this most observable composition be express'd in his *Definition*; and forasmuch as that of a *Reasonable Animal* doth not include any such thing, it is evident that it doth but imperfectly declare the nature of the thing defin'd.

Moreover *Man* in the foresaid *Definition* is placed under the General *Head*, or notion of *Body*, when with better reason he ought to be rank'd under that of *Spirit* (for the *Soul* is the Principal part of *Man*, and if well considered, is more known than the *Body*; for we may doubt of the *Existence of Corporeal Beings*, whereas we cannot doubt of the *Existence of our Soul*) as in all other things the denomination is always wont to be made from the more noble part; and if by evil custom, and the prejudices of our *Infancy* we have taken our *Body* to be our best and most noble Part, *Philosophy* ought to have corrected this mistake, and not to have cherish'd and strengthened it.

But you'll say that *Philosophers* have thought good to define *Man*, rather by his more ignoble *Genus*, viz. *Body*, than by that of *Spirit*, because *Man*, as to his external parts and appearance, is much more like a *Beast* than an *Angel*, and that therefore it was more proper he should be ranged under the meaner *Genus* of *Body*, than under that more sublime of *Angels*.

I Answer, that this is no better than a frivolous reply, as being not at all founded upon *Reason*, but *Custom* only, and the prejudices suckt in from our *Infancy*. For the question here is not about what objects our thoughts are most employ'd, but about what they ought to be employ'd; and that these are those things that are endued with *understanding* no *Man* will deny, these being much more excellent than *corporeal things*, and to which our *mind*, because of the affinity it hath with them, is most inclined, the herself being of an *Intelligent* or *Thinking Nature*. Now the reason why *Men* chiefly addict themselves to *Corporeal* and *sensible Things*, is because they think that their *Nature* or *Essence*, hath a greater affinity with *Visible Things* than with those that never fall under their *Senses*, and can only be reached by their *thoughts*, or intellectual faculty. Which Error ought certainly to be corrected by those who may glory of their being made after the Image and likeness of God.

We must therefore look out for a more accurate *Definition of Man*, and such a one, if I be not mistaken this is: *A Man is a thing compounded of a Finite Mind, and a rightly disposed or framed Body*. For seeing that *Man* is not a simple thing, but composed of both kinds, viz. of a *Soul* or *Mind* and *Body*, it is necessary that this notable composition which distinguisheth *Man* from all other things, should be express'd in the *Definition* by this word *Compounded*; and by this means all the conditions of a good and lawful *Definition* are secured and preserved; the First whereof is that it express and declare the *Nature of the thing*, and the several parts whereof it is compounded. For there is nothing to be found in *Man*, which is not express'd in this *Definition*. Secondly, that the *Genus* and *Difference* be rightly assigned; for that *Man* consists of a well disposed or framed *Body*, this he hath in common with other *Animals*, and that he is endued with a *Finite Mind*, that is such an one as is not altogether perfect, he is distinguish'd from *God*, who is the *Infinite Mind*. Thirdly, that the *Definition* be not more extensive than the thing defined, nor more contracted or narrow, but equal with it; for it is manifest from *Induction* that every *Man* whatsoever is compounded of a *Finite Mind*, and a *Body* rightly disposed; so that of whatsoever the thing defined is predicated, of the same the *Definition* may be predicated also.

From this *Definition* we may infer First of all, that *Soul* and *Body* are the parts of a *Man*; as a part is taken for that, whereof any thing doth consist. Secondly, that the *Union* of the *Soul* with the *Body*, is the *Form of Man*; since wheresoever that union is, the compound is likewise, as where it is not, the compound is not, viz. *Man*. Which *Union* of the *Soul* with a *Human Body*, doth consist in the mutual *Action* of the *Soul* and *Body* upon each other, as shall be shewed in the following Part.

And whereas the other part of this *Definition* is a *Body rightly disposed*, we are to take notice that this disposition doth consist in such a *Modification*, whereby the body is fitted for an intimate union with a *Human Soul*. Wherefore every Portion of *Matter*, that is so modified, whether it be *Organical* or *Inorganical*, may properly be called a

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VIII.
The true
Definition
of Man.

IX.
What may
be inferred
or gather-
ed from the
Definition.

X.
What a
rightly
disposed Bo-
dy is.

IV.
Neither is
reasonable
the differ-
ence of
Man.

V.
A Rational
Animal
doth not
perfectly
explain the
Nature of
Man.

VI.
A Man is
wrongly
placed un-
der the re-
mote Ge-
nus of a
Body.

VII.
Why in de-
fining of
man, we
ought to
have more
regard to
his Soul
than to his
Body.

Human Body, since the *Essence* of *Man* wholly consists in the *Union* of his *Soul* with his *Body*, and that it will be his *Body* as soon as it is united to him. Neither is it any whit clear or evident, that *Organs* are of absolute necessity to this *Union*; for I can see no reason why an *Inorganical Body* may not be so disposed, as to be fit to receive a *Soul* for its *Form*. Neither can a *Man*, if we have respect to his bare *Essence* only, be said to be imperfect, because he is destitute of *Organs*, forasmuch as a *Man* that hath lost both his *Arms* and *Legs*, doth not cease to be a perfect *Man* for all that, as being no less a *Man*, than he who enjoys all his *Members*, because the perfection of a *Man* as such, consists in the union of his two *Essential Parts*, viz. of *Soul* and *Body*. And as his *Soul* is said to be perfect, because it hath that disposition which on its part is required for its union with the *Body*; so that *Body*, whatsoever it be, provided it only have such a disposition that it may be united with a *Soul*, is to be called a perfect *Human Body*. But forasmuch as we here consider *Mans Body* in its *Natural State*, we shall describe it here as it is *Organical*, and consisting of all its *Parts*.

CHAP. II.

A Description of the External Parts of Mans Body.

I.
It is sufficient for a young Scholar in Philosophy to know the more principal parts of Mans Body.

II.
How many Similar parts there be in the Body of Man.

III.
How many Dissimilar

VERY wonderful is the *Structure* of *Mans Body*, if we consider all its *Parts*, and the use or end for which they were framed: but because it would require too much time and pains, to give here a particular account of them all; and because that belongs rather to a *Physician* than a *Philosopher*, I shall only touch at the more *Principal Parts*, passing by those which would rather confound first beginners than inform them.

For the better understanding of them, we must observe that the *parts* which constitute the *Body* of *Man*, are either *Similar Parts*, or *Dissimilar*. *Similar* are those whose *Substance* is the same, and alike throughout: or which may be divided into *Parts* of the same nature and Denomination; and of these I I are reckoned up by *Physicians*, viz. *Bones*, known by their great hardness and firmness; *Gristles*, which are the next in solidity and firmness to that of *Bones*, and of which the *Ear* consists. *Tendons*, which are the ends or extremities of the *Muscles*; *Ligaments*, which approach to the nature of *Tendons*, and serve to join 2 solid parts together, viz. *Bones* to *Bones*. *Fibres*, which are as it were the *Woof* of the other parts. *Membrans*, which are thin and broad *Substances*, serving for a covering to several *parts*: such as are the *Membran* or *Skin* that covers the *Ribs*, the *Bladder*, the *Stomach*. *Arteries*, which convey the *Vital Blood* from the *Heart* to all the parts of the *Body*. The *Veins* which convey the *Blood* back again from the parts to the *Heart*. The *Nerves* or *Smews* which carry the *Animal Spirits* from the *Brain* and the *Marrow* of the *Back Bone* to all parts; and the *Flesh* and the *Skin*. To which may be referred also the *Fat*, *Nails* and *Hair*, as being parts completing the whole, and of a similar nature.

Dissimilar Parts are such as are made up of several *Similar Parts*; or which may be divided into *Dissimilar Particles*, as a *Hand*, *Foot* which

may be divided into *Skin*, *Flesh*, *Bones*, *Veins*, *Arteries* and *Nerves* which are of a different Nature and Denomination. And such are the *Head*, *Neck*, *Breast*, both the *Arms*, *Legs*, &c.

The first and Principal part of the *Human Body* is the *Head*, which contains the *Organs* of *Sense* and *Motion*, and is the *House* or *Abode* of the *Soul* it self. It is round or *Spherical*, but somewhat compressed or *flatted*, and longish: and for its better security, is all covered with *Bones*. And is placed in the highest part of the *Body*, according to *GALEN*, for the *Eyes* sake, which are placed there as in a *Watch Tower* to take a prospect of all objects round about it.

The *Head* is divided into the *Hairy* part or *Scalp*, and that without *Hair*, called the *Face*. The *Forepart* of the *Hairy Scalp*, from the *Forehead* to the *Sutura Coronalis*, is called *Sinciput*, that is, the *Forepart* of the *Head*; and that which reacheth from the *Sutura Lambdoidea* to the first Joint of the *Neck*, is called *Occiput*, or the *Hinder Part* of the *Head*; the middle and *Gibbous* part between both these, is called *Vertex* or the *Crown* of the *Head*. The part without *Hair*, that is, the *Face*, hath also its several parts, the *Forehead*, or superior part, which bears the Signs of the *Mind*; and the Inferiour in which are the *Organs* of the *Senses*, as the *Eyes*, *Nosrils*, *Ears* and *Mouth* which hides the *Tongue*.

There be two outward *Membrans* that encompass the *Skull*, the *Pericranium* or *Skin* so called from its going about the *Skull*, which is a soft and thin *Membran*; and the *Periostrum*, which is a most thin *nervous Membran*, so closely joined to the *Pericranium*; that they seem only to constitute one *Membran*. To which are conjoined the *Inward Membrans* that infold the *Brain*, which are likewise 2, viz. a thin one, that immediately covers the *Brain*, and is called *Pia Mater*, and a thick one, which is called *Dura Mater*. They are commonly called *Meninges*, and by the *Arabian Physicians*, *Matres* or *Mothers*, because they supposed all the *Membrans* of the *Body* derived and propagated from these.

To these *Membrans* the *Vital Blood* is conveyed by the outward Branch of the *Arteris* called *Carotides*, and that which is left after the *Nourishing* of their parts, is by small *Veins* sent back to the *External Jugulars*. Some believe that these *Arteries*, passing through the little holes of the *Skull*, do penetrate and pass into the great *Bosom* or cavity of the *Dura Mater*: tho' this doth not seem probable, since they tend only to the *Diplois*, and in it do vanish or disappear.

The *Neck* is that part of the *Body* which is between the *Breast* and the *Face*, and supports the *Head*, being called *Collum*, & *Colendo*. Because it is commonly much adorned. It is somewhat longish, to assist the tuning of the *Voice*. Accordingly those *Animals* that utter no *Voice*, as *Fishes*, want a *Neck*; and those that have a strong *voice*, have the longer *Necks*, as *Cranes*, *Geese*, &c. The hind part of the *Neck* is called *Cervix*; and the forepart *Guttur* or the *Throat*. The *Neck* consists of 7 Joints, which are the upper part of the *Spine*. In the forepart of it are 2 great *Pipes*, whereof the one is called the *Wind-Pipe* or *Rough Artery*, because of its unequal *Gristly Rings*, and serves to convey the *Air* to the *Lungs*, and from thence

Parts there be in Mans Body.

IV.
The Head.

V.
The Parts of the Head.

VI.
The Membrans wrapping the Skull.

VII.
How the Blood comes to show.

VIII.
What the Neck is.

out of the Body. The other inward *Pipe* is the *Gullet*, by which the *Meat* and *Drink* is conveyed from the *Mouth* to the *Stomach*.

IX. *The Breast.* Next to the *Neck*, the *Breast* begins, which is that part of the *Body* which contains the *Heart*, *Lungs* and *Vital parts*: Its hind-part comprehends, besides the *Shoulder-blades*, the *Back*, and 12 Joints of the *Spine*; from whence 7 *Ribs* do proceed, having their Ends cloathed or cover'd with *Gristles*, which are called the true or perfect *Ribs*; because they Circle-wise compass the hollow of the *Breast*, reaching to the *Grisly* or *Spongy Bone* called *Sternum*, and ending downwards in the *Gristle* that resembles the figure of a *Sword*. In the Middle of the *Breast* are 2 *Dugs* or *Paps*, on each side one; situated there, First, in order to their being near the *Heart*, to receive *heat* from thence: Secondly, for Comeliness sake: Thirdly, for the more convenient Suckling of *Children*. They are 2 in number; not for to Suckle *Twins*, as some will have it, but to the end that if one of them should come to any hurt, the other might supply the place of it, and perform the Function alone.

X. *The Dugs consist of two parts.* The *Dug* is divided into the *Nipple*, and the *Pap* it self. The *Nipple* is a *Spongy* kind of *flesh*, and therefore is at sometimes more loose and flaggy, and at other times more stiff, especially when suck'd or touch'd. The *Dug*, or *Pap* it self, inwardly consists of a *Membran*, *Vessels*, *Kernels*, or rather *Kernel-like Bodies*, and *Fat*. In *Men* the *Dugs* are not so great or prominent as in *Women*, theirs being not commonly designed for the *Generation* of *Milk*; yet to shew the Equality of kind in both *Sexes*, it was not fitting that *Men* should be altogether without them.

XI. *The Belly.* Under the *Breast* is the *Belly*, whose fore-part is called *Abdomen*, and in its Middle is the *Navil*; the upper part whereof is the *Hypochondrium*, which Name is also given to its Sides. Beneath are the *Groins*, and the *Parts* designed for *Generation*. The Upper-part of the *Abdomen*, reaching up to the *Midriff*, is the *Stomach*, which lies Cross-ways, and which having received the *Food* from the *Mouth*, by means of the *Gullet*, doth digest it into *Chyle*; and afterwards sends the purer part of the *Chyle*, by the *Subclavial Branches* of the *Vena Cava*, into the *Vena Cava* it self.

XII. *The Back-parts of the Body.* The Hinder-parts of the *Body* are the *Shoulder-blades*, to which the *Shoulders* are joyned, and to them the *Arms* with the *Elbow*. For by the word *Arm*, we understand all that part which reacheth from the *Shoulder*, where the *Collar-bones* end, to the *Fingers* ends; tho' commonly the *Hand* is not comprehended under the word *Arm*. The *Arm* consists of 3 conspicuous *Parts*, viz. the Upper-part of it called *Lacertus*; the Middle-part of it, from the *Elbow* to the *Wrist*, called *Cubitus*, and the *Hand*. The Upper-part of the *Arm* hath one only *Bone*; the Middle-part hath two *Bones*; the Lower, which is called *Ulna* or *Cubitus*, and the Upper called *Radius*. The *Hand* also consists of 3 *Parts*, viz. the *Wrist*, the part between the *Fingers* and the *Wrist*, called *Metacarpium*, and the *Fingers*; the *Fingers* have each of them 3 *Joints*. The *Hands* are 2, the *Right* and the *Left*. Next to the *Shoulders* are the *Loyns*, and near to them the *Os Sacrum*, distinguish'd as it were into 5 *Bones*, having on each side of it the

Bone Ilium, jetting out like a *Bow*, and the *Hip-bone*; and under these the *Buttocks*.

The use of the *Flesh* is, to cover the *Bones* and *Members* of the *Body*, more especially the *Inward parts*, and to hinder them from falling asunder. It is made up of the *Substance* of the *Blood*, by the coagulation of its thicker *Parts*. The *Fat* in its nature is like to *Flesh*, and proceeds from the same *Principle*. Its Function is to preserve the *Natural heat*, to defend the *Parts* it covers from *Outward hurts*, and by moistning and smoothing the dryer *Parts* of the *Body*, to assist and promote motion.

Flesh is fourfold; *Viscerous*, *Membranous* or *Skinny*, *Glandulous*, and *Musculous*, or that of the *Muscles*. The *Viscerous* is that whereof the *Inwards* consist, and is nothing else but an affusion of *Blood*, which supports the *Vessels* of the *Inwards*, by filling the empty *Spaces* that are between them, and assists the *Concoctions* and *Separations* that are made in them. The *Membranous Flesh* is nothing else, but the *Fleshy Substance* of every *Membranous part*; as of the *Gullet*, the *Stomach*, the *Guts*, the *Womb*, and the *Bladder*. *Glandulous Flesh* is that of the *Kernels*; the use whereof is either to soak up the superfluous *Humours* (for they are of a *Spongy Substance*) as those in the *Neck*, under the *Armpits*, and in the *Groin*; or they are in order to the moistning of the *Parts*, for their more ready motion, or to prevent the dryness of the *Parts*. The *Musculous*, which GALEN calls the *fibrous* or *stringy Flesh*, is that soft and red Substance, which is *Flesh*, properly so called.

The *Bones* are the strength and support of the *Flesh*, and are the insensible *Parts* of the *Organical Body* of an *Animal*; as also the hardest and driest, containing the *Marrow* within them. There are 304 of them in the *Body* of *Man*, which are of diverse figures, according to their different uses; for some of them are round, others flat; some sharp, and others blunt, &c. It is a mistake to think the *Bones* to be without *Blood*; for they are Red in the *Womb* before the *Infant* is born, are found to have small *Vessels* in them, from whence *Blood* gusheth forth; and when they are broke, the *Callous matter* that joyns them again together, sweats *Blood*. The *Muscles* follow the bigness and figure of the *Bones*, to which they are joyned; and move those *Members* of the *Body*, to which they are particularly destinated. The *Nerves* or *Sinews* have fibres or strings, extended long-ways, and are the Instruments of *Sense* and *Motion*.

Lastly, This whole Bulk is supported by the *Feet*, assisted with the *Leg* and the *Thigh*, with the *Knee* that joyns them both together. The *Thigh* hath only one *Bone* in the Upper-part, whereof, besides the round *Head*, inserted in the hollow end of the *Huckle* or *Hip-bone*, there is a kind of *Neck*, whence 2 Ends shoot forth, which are called *Trochanteres*: And in the Lower-part this *Bone* is so joyned with the *Chief-bone* of the *Shin* or *Leg*, that in the foremost Hollow of the jetting out of the *Bone*, there is a place for the *Bone*, called the *Knee-pan*, which hinders the *Leg* from bending forwards. To the Lower-part of the *Foot* 3 parts concur, viz. the *Heel*, the *Sole* of the *Foot*, which is as it were its Back, and is made hollow in the midst,

XIII.
The Flesh.

XIV.
The Differences of Flesh.

XV.
The Bones.

XVI.
The Feet.

midst, to the end it might the more firmly stick to the Ground in going ; and the 5 Toes , which are very helpful to progressive motion.

CHAP. III.

A Description of the Principal Inward Parts of the Body of Man.

I.
The Brain,
which is
the most
principal
Part of
Mans Body,
examined.

THE Skin being pluck'd off, the *Flesh* is more distinctly perceived ; which is not a continuous *Mass*, but distinguish'd into several *Muscles*. But the chiefest and most principal Part that presents it self, is the *Brain* ; which in *Man* is the greatest in Bulk, with relation to other *Animals*. The *Bark*, or outside part of it, appears distinguish'd into a thousand turnings and windings, not unlike the Cronckelings of the *Guts*, with far greater variety than in any other *Animal*. All which crooked Windings are covered with a thin *Membran*, and are moistened with innumerable *Vessels*, which being in a most wonderful manner woven together, are dispersed every way, and in some places penetrate the inward Substance of the *Brain*. Tho' indeed all the *Veins* and *Arteries* that penetrate the *Substance* thereof, are but small and few ; but are more copious in the *Cavities* or *Ventricles* of it, and other places which are cover'd with the *Pia mater* or thin *Meninx* : For that *Membran* doth not only separate the *Brain* from the more inward Part that lies under it, but distinguisheth it also in divers parts, and invests all the deep furrows and foldings of the *Bark* or outward part of the *Brain*, conjoyns the more prominent parts of them, forms almost innumerable *Cavities*, and every where twists most wonderful pleats and textures of the *Vessels*.

II.
The Brain
is divided
into two
Parts.

The *Brain* is divided into 2 parts, viz. into the *Fore* and *Hind-part* : The *Fore-part*, which is much bigger than the other, is chiefly called the *Brain* ; the *Hind-part* is called *Cerebellum* or the *Little Brain* ; and tends downward, being continued to the Marrow of the *Back-bone*, and cover'd with both the *Meninges*. Within the *Substance* of the *Fore-part* are two *Cavities*, so placed as to answer to a third Cavity in the *Hind-part* : And above the Passage, whereby the foresaid 2 *Cavities* have intercourse together, is the famous *Kernel* called *Glandula Pinealis*, from its figure, resembling that of a *Pine-Apple*, and *Conarion* from its *Conical* figure. The bottom of this *Gland* or *Kernel* is fastned to the *Brain*, whereof it is a part, and is seated in the very midst of the two *Cavities*. This *Kernel* hath that of Singularity, that it is one only, whereas all the other that are found in the *Brain* are double.

III.
Of the se-
ven pair
of Nerves,
derived
from the
Brain, ac-
cording to
the Opinion
of the
Ancients.

The *Ancients* were of Opinion, that 7 pair of *Nerves* only were derived from the *Brain* ; whereof the first, were the *Optick Nerves* ; the second, those that help to move the *Eyes* ; the third and fourth, appropriated to the *Taste* ; the fifth, to the *Ears* ; the sixth was, that which is called the *wandering Pair* ; and the seventh and last, those that move the *Tongue*. But in this enumeration, they have left out that *Pair*, which being convey'd to the *Nostrils*, are the Instruments of *Smelling*, and have divided the third *Pair* into two ; and the fifth *Pair*, which they suppose single, is double : So that whereas they make but 7,

others 8, and others 9 Pair of *Nerves*, we make 10 in all. The first *Pair* are appropriated to the sense of *Smelling*, the ends whereof reaching from the *Brain* towards the *Nostrils*, are called *Processus Mammillares*. The second is the *Optick pair*, subservient to the *Sense* of *Seeing*. The third, moves the *Eyes*. The fourth, serves to turn and writh the *Eyes* variously, suitable to the diversity of *Passions* that assail us. The fifth is, that by which the *Tongue* doth *taste*. The sixth is conveyed to the *Palat*, for the same purpose. The seventh is lost in the *Muscle* of the *Eye*, called the *Abductor* or *Drawer aside*. The eighth assists the *Drum* of the *Ear*, in its dilatation or expansion. The Ninth pair, which is called *Wandering* by others, is that which furnisheth all the *Inward parts*, situate in the middle and lower *Belly*. The Tenth and last *Pair* is by strong *Membrans*, joyned with the former *Pair*, for the strengthening of them.

But forasmuch as the pith of the *Back-bone* is nothing else, but a *Continuation* of the substance of the *Brain*, it is certain that from the same several pairs of *Nerves* do proceed ; viz. 7 to the *Neck*, 12 to the *Back*, 5 to the *Loyns*, 6. to the *Os sacrum* ; and all these *Nerves* are nothing else, but the continued Substance of both the *Meninges* or *membrans* of the *Brain*, there being none amongst them that are not twisted of them both. These *Nerves* proceeding from both sides of the Pith of the *Back-bone*, are called *Pairs*, as being always double.

IV.
Several
Pairs of
Nerves
proceed
from the
Pith of
the Back-
bone.

In the *Breast* hangs the *Heart*, of a *Pyramidal* figure, resembling a *Pine-Apple*, with the Point of it inclining towards the Left-side ; so as that the Left-part of the broad End, which is the beginning of the *Great Artery*, is situated much about the Center of the *Chest*. The Greatness of the *Heart* in *Man*, proportionably exceeds that of other *Animals*, and commonly weighs about 7 *Ounces*, being about 6 Finger-breadths long, and 4 broad. Not but that the bigness thereof sometimes varies.

V.
The Heart.

In the *Heart* are 3 sorts of *Strings* or *Fibres*, some *Transverse* or *Cross-wise*, others *Crooked* or *Oblique*, and a third sort that are *Strait*, by which the dilatation or swelling of the *Heart*, when the Point of it is drawn up towards the broad End of it ; and the *Contraction* whereby the said Point is withdrawn from the *basis* or broad End of it, are performed. There be 2 *Ventricles* or *Cavities* in the *Heart*, which are separated from each other by a part of the *flesh* of the *Heart*, called the *Septum medium*, or the middle partition Wall, the *Right Ventricle* being more ample and large than the *Left*. Two very large *Channels* answer to both these *Ventricles*, to wit, the *Vena Cava*, which is the principal *Receptacle* of the *Blood*, and is as it were the *Trunk* of the *Tree*, whereof all the other *Veins* are the *boughs* and *branches* ; and the *Arterial Vein*, which ariseth from the *Heart*, and after that it is come forth from thence, divides it self into many *branches*, which are afterwards dispersed through the *Lungs*. In the Left-side there are likewise 2 corresponding *Channels*, as large as the former, if not larger, viz. the *Venal Artery*, which is derived from the *Lungs*, where it is divided into many *branches*, which are intermixed with the *branches* of the *Arterial Vein* and the

VI.
Of the
Dilatation
and Con-
traction
of the
Heart.

Wind-

Wind-pipe, by which the *Air* we attract doth enter; and the *Great Artery*, which proceeding from the *Heart*, disperfeth its *branches* throughout the whole *Body*. Each of these *Cavities* have 2 *Openings*, placed towards the *basis* or broad End of the *Heart*: And in the entrance of these *Openings*, are some *little Skins*, which like so many *flood-gates* do open and shut 4 *Mouths* or *Orifices*, that are in both those *Cavities*; viz. 3 in the entry of the *Vena Cava* or *hollow Vein*, which are so placed, that they cannot hinder the *Blood* they contain, from flowing into the *Right Ventricle* of the *Heart*, tho' they hinder any from coming out thence. 3 in the Entry of the *Arterial Vein*, which are ranged the quite contrary way, so as that they suffer the *Blood*, contained in that *Cavity*, to pass to the *Lungs*; but by no means will suffer that which is in the *Lungs*, to return thither again. And so likewise there are 2 more in the *Orifice* of the *Venal Artery*, which permit the *Blood* to pass from the *Lungs* into the *Left Ventricle* of the *Heart*, but hinder its return thither again. And 3 at the entry of the *Great Artery*, which suffer the *Blood* to come from the *Heart*, but hinder it from returning thither again.

VII. The *Heart* is enclosed in a *Nervous membran*, called *Pericardium*; where it swims in a *Liquor* not much unlike to that of *Urin*; the broad End of it taking up the *Center* of the *Breast*, whilst the *Point* of it sways downwards, to the *Left-side* of the *Midriff*.

VIII. The *Lungs* are a *Spongy Substance*, of a whitish or pale red Colour, and are divided in the *Right* and *Left* part by the *Mediastinum*, or the *membran* that divides the *Breast*, from the *Throat* to the *Midriff*, into 2 *Bosoms*; both which *Parts* are distinguish'd into several *Lobes* or *Lappets*, in order to their better covering and surrounding of the *Heart*, which is placed in the *midst* of them. In that part of the *Mouth* which is at the *Root* of the *Tongue*, is a *Channel* called the *Wind-pipe*, which passing downwards is divided into many little *branches*, which are disperst throughout the whole Substance of the *Lungs*, in the same manner as the *Venal Artery*, or the *Arterial Vein*. This *Wind-pipe* receives the *Air* that is taken in by *breathing*; and because the *membran* thereof is so hard and stiff, that it cannot easily be compress'd or clos'd together, it continues always full of *Air*, and by this means causeth the great *Lightness* of the *Lungs*. Our *Meat* and *Drink* cannot pass from our *mouh* into the *Gullet*, without passing over the *Mouth* of the *Wind-pipe*, tho' nothing can fall into it, because of a little *Valve* which covers it, whenever we swallow any thing. The *Lungs* also have their *Dilatation* and *Contraction*; their *Dilatation* being caused by the *Air* entring into their *Substance* through the *Wind-pipe*; and the *Contraction* by the expulsion of it.

IX. Under the *Lungs* and the *Heart* is placed the thick *membran*, called the *Diaphragm* or *Midriff*, which separates the *Breast* from the *Belly*. It hath 2 *Holes*, through which the ascending *Hollow Vein*, and the *Gullet* which goes down to the *Stomach*, do pass. The *Midriff* lends also its assistance to the function of *Respiration*, to which it contributes rather, as it is a *Musculous membran*, than a *Muscle*.

X. Under the *Diaphragm*, the *Liver* is placed on the *Right-side*, and the *Spleen* on the *Left*. The

Liver in *Man*, as well as in most other *Animals*, seems to be nothing else but *Clotted blood*, of a *Reddish colour*. Tho' there be some *Animals* that have it of a *green*, others of a *yellow*, and others of other *Colours*. The *Ancients* were of *Opinion*, that the *Blood* was prepared in the *Liver*, and that the *Chyle* was there turned into the form of *Blood*. But the contrary has been since made out, it being no longer question'd now, but that the *Chyle* is conveyed from the *Receptacle* of the *Lacteal Veins* upwards, to the *Subclavial branches* of the *Hollow Vein*, and thence into the ascending *Trunk* of the said *Hollow Vein*, whence it is carried together with the *Blood*, returning from all the parts of the *Body*, into the *Right Ventricle* of the *Heart*, without passing the *Liver*. The *Gall-bladder* is joyned to the *Liver*, a small *Channel* proceeding from it, which becomes immediately parted into 2, whereof the one bends downwards towards the *Liver* again, and enters it; whereas the other, called *Choledochus*, is inserted into the lower end of the *Duodenum*, whither the *Gall* is conveyed, through a very little and almost insensible *Orifice*.

The *Spleen* is situated on the *Left-side*, under the *Midriff*, between the *Stomach* and the *Ribs*. It is of a *Spongy Substance*, cover'd with a thin *membran*, received from the *Peritonaeum* or *Inner-rim* of the *Belly*. Its more prominent or gibbous part is fastned to the *Midriff*; which is the Reason why those that are diseased with a *Schirrhus*, or any other swelling of the *Liver*, do complain of a difficulty of *breathing*. It abounds with a thick dreggy *Blood*, and is fastned to the *Stomach* and *Back*, by means of the forefaid *membran*, and hath a communication with the *Heart* by certain *Arteries* and *Veins*. The *Spleen* is almost as long again as it is broad; the *Upper-part* of it butting out like a *Bow*, the *Lower-part* of it ending in an obtruse *Angle*, and in the *midst* somewhat hollow and deprest.

Between the *Liver* and the *Spleen* lies the *Stomach*, into which all our *Meat* and *Drink* is conveyed through the *Gullet*. It hath 2 *Orifices*, the one whereby it receives in our *Nourishment*, which it dissolves and turns into *Chyle*; the other called *Pylorus*, by which it thrusts it down into the *Guts*.

For the *Guts* take their rise or beginning from the *neather Orifice* of the *Stomach*, and after many windings are terminated in that part, by which the grosser *Excrements* are voided. To speak properly there be no more than one *Gut*, to the different parts whereof *Anatomists* have assigned different Names. That which is next to the *Stomach* they call *Duodenum*, the extent of which is not above 12 fingers breadth: The second is called *Jejunum*, from its almost continual emptiness: The third is called *Ilium*, from its various windings: The fourth, *Colon*, whence the Disease called the *Colick* takes its Name: The fifth is a little Appendix betwixt the *Ilium* and *Colon*, which is called *Cecum*, or the *Blind-Gut*: And the sixth *Rectum*, or the *Strait-Gut*. The 3 former of these are called the *thin Guts*, and the rest the *great* or *thick Guts*.

The *Mesentery* is a *Membranous expansion*, interwoven with *Kernels* and *Fat*, placed at the back-part of the *Guts*, and with its *Center* or narrowest part tied to the *Loins*; but with its *Circumference*

XI.
The Spleen.

XII.
The Stomach.

XIII.
The Guts.

XIV.
The Mesentery.

CHAP. IV.

Of the Forming of the Birth in the Womb,
and of its Animation.XV.
The Caul.

cumference infolding all the *Guts*, and fastning them to the *Back*. Its figure is almost Circular, so as that its compass answers to the length of the *Guts*; but yet is so framed and folded, that it keeps within narrow Bounds.

The *Caul* is another *Membranous expansion*, consisting of a double *membran*, distended to an Orbicular figure, like to a *Faulkners Pouch*, interwoven with many *Arteries* and *Veins*, and great store of *Fat*, deriving its 2 wings or foldings from the *Stomach*, *Liver*, *Spleen*, the *Rim of the Belly*, and the *Gut Colon*; and not only covering the *Guts*, but following the windings and turnings of them; so that with regard to its situation it may well be called *Epiploon*, that is, swimming on the top, such being the situation of it with respect to the *Guts*.

XVI.
The Womb.

The *Womb*, which is also called the *Matrix*, is an *Organical part*, serving for *Generation*, situate in the lower part of the *Belly*, betwixt the *Bladder* and the *Strait-Gut*, lodged in a strong *Bason*, made by the *Bones Ilium*, *Coxendix*, and *Sacrum*; which *Bason* or *Hollow* is larger in *Womer*, than in *Men*, in whom also when the time of their *Delivery* is at hand, it is yet further enlarged by the plying and giving-way of some of the strong *Ligaments* about the *Bones Sacrum* and *Pubis*, and by the starting back of the *Bone* called *Coccyx*, to make way for the *Birth* to struggle out of his *Prison*.

XVII.
The Kidneys.

Besides these *Parts* already mentioned, there are also 2 *Kidneys* that are fastned to the *Joints* of the *Back-bone*. Their Substance appears like to that of a curious *Sponge*, and in each of them is found a certain *Cavity* or *Hollow*, called the *Dish* or *Bason*, which is generally fill'd with *Urin*.

XVIII.
The Ureters.

The *Ureters* are 2, viz. on each side one, carrying the *Urin*, that hath been separated in the *Kidneys* to the *Bladder*. They are nothing else, but an innumerable company of small *Nervous fibres* twisted together, and therefore no wonder that they are so exceeding sensible; for as soon as any one of their finest *Strings* is moved, all the rest are shaken and tremble, whence there ariseth in the *Soul* an *Idea* of the sharpest *Pain*.

XIX
The Bladder.

Anatomists commonly attribute but 2 *Coats* or *membrans* to the *Bladder*; but if they be viewed with a *Microscope*, we shall find them to be many more, even to the number of 20. The *Bladder* is the receptacle of the *Urin*, conveyed through the *Ureters* from the *Kidneys*; which afterwards by the contraction of the *fibres* of the *Bladder*, are by the *Urethra* or *Urinary-passage* evacuated.

XX.
The Testicles.

The last *Parts* to be consider'd, are the *Testicles*, which are *Vessels* design'd for *Generation*, tho' it may be doubted, whether the *Generation* of *Seed* may be wholly attributed to them; because there was never found any perfect *Seed* in the *Testicles* of the most *Libidinous Animals*. Yea, many do witness, that *Bulls*, *Horses*, and other such like *Robust Animals*, have generated their *Like* for many years together, after their having been *geld*, and that they are not robb'd of their *Prolifick virtue*, except their *Spermatick Vessels* be taken away together with their *Testicles*. Wherefore it seems more probable, that the *Seed* is produced in the little *Bladders*, *Kernels*, and *Pores*, that neighbour upon the *Bladder* and the *Womb*. But we leave this to be determin'd by *Physicians*.

The Common Opinion is, that the *Matter* whereof the *Birth* is formed in the *Womb*, doth consist of the *Seed* of both *Parents*, the *Female Blood* being mix'd with it: Nor indeed have the *Ancients* question'd, but that the *Woman* doth contribute her part of *Seed* to the *Conception*, and efficiently concur to *Generation*; for both *Sexes* seem to have like *Instruments* for the generating of *Seed*. The *Women* have their *Testes*, in which the *Blood* is strained and purified, and a ferous and thickish *white Matter* is squeezed out of them, which seems to be design'd for *generation*. Besides, we find that the *Birth* resembles the *Mother*, as well as the *Father*; which we cannot well conceive how it should be, if both of them did not contribute *Seed* to the production thereof.

But to the end we may understand by what *Artifice* an *Animal* comes to be formed, from a *Moisture* without all *Form*, so as to bear some resemblance with the *Principle* from whence it did proceed; it is commonly supposed, that the *Seed* both of *Male* and *Female* flows down from all their *Parts*, so as that there is no *Member* in their whole *Bodies*, whence some part of the *Seed* is not derived. For as the *Serous humour* is by the *Veins* separated from the whole *Body*, and through the *Vessels* call'd *Emulgentes* carried to the *Kidneys* and *Bladder*, in which latter place it is kept till it be voided: In like manner, say they, seeing that 2 *Veins* and 2 *Arteries* enter into the *Testicles*, why may not the *Seminal particles* flow from the whole *Body* into them, and from them into the *Vessels* destinated for their reception; and this not slowly and by degrees, but in a very short Space, wherein the whole *Body* is powerfully stir'd up to an excretion or separation of what is most *Spirituons* in all the *Parts* of the *Body*?

Many *Arguments* might be alledg'd to prove this *Point*; but there are some *Examples* thought to be so clear and evident, as to supersede the necessity of many *Proofs*: A *Cat*, whose *Tail* was cut off when she was but young, litter'd *Kittlings*, whereof some had *Tails*, and others wanted them: And a *Bitch*, that was wont to bring forth sound *Puppies*, having broke her *Leg*, did ever after bring forth lame *Puppies*. Now to what can this resemblance of *Puppies*, with their *Dams*, be imputed, but because the *Seed* is conveyed from all the parts of the *Body*, so that perfect *Births* are born of sound and perfect *Parents*, and maimed and defective from such as are so. And if it sometimes happens, that whole and sound *Births* do proceed from maimed and defective *Parents*, this must be ascribed either to the Soundness of one of the *Parents*, or to the great *Vigour* of the *Spirits*. However, when it so happens that maimed *Births* proceed from maimed *Parents*, no other Reason seems so satisfactory, as that which hath been alledged.

From what hath been said, may in some sort be understood, how the *Birth* comes to be formed in the *Mother's Womb*; because the insensible *Parts* of the *Male* and *Female Seed* have already received such a *Configuration* in the *Body* of the *Parents*, that they are no sooner received into the *Womb*;

I.
Whether the Seed in Generation, proceeds from both Sexes.II.
The Seed flows from all parts of the Body.III.
Proved by Examples.IV.
How the Birth is formed in the Womb.

but being there intangled together, and agitated by heat, they are turned into a rude delineation or Rudiment of the Animal, from which afterwards all the parts are perfected and compleated. For those parts which before, for example, did belong to the Head, Belly, &c. become now so disentangled and separated from others, so as to be now at liberty to run together, and from the several distinct parts of the Body; so that those parts which proceeded from the Brain, do now unite to constitute that part, those of the Eyes, the Eyes and so for the rest. Much after the same manner as the like grains of Sand, and the filings of Lead do come together, and make several heaps: as when we fasten a Pipe to a Bladder, and through it cast Earth, Sand and Filings of Lead, and having poured water upon them, if then we blow through the Pipe, all these matters will be variously mingled and tost together, but as soon as the said agitation ceaseth a separation is made, the Lead settling with the Lead, the Sand with the Sand, &c. and in this condition we shall find them, if after the drying up of the water we shall rend the Bladder, that is, we shall find the like particles to be gathered to their like. And after this manner we may conceive that the particles of the Seed become so disposed as to make the first Rudiment of a Birth.

If you demand how it can be that from such a small quantity of Insensible particles, a Body should arise, resembling the great Body from whence it proceeded, and representing every one of its Parts and Members.

It is Answered, that this is done much in the same manner as we find that a very little Image in a Convex Glass represents a Man; for this Image is therefore so little, because only a few rays are reflected to the Eye, from the several parts, many of the Rays rebounding elsewhere by reason of the convexity of the Glass, which makes that only a few Beams from each part do reach the Eye, which meeting in the Retina or Network Membran of the Eye, do represent a very little Man: In like manner, the first Rudiment of a Human Birth in the Womb, is indeed very little, and yet resembles the great Body, exactly as to the number of its parts, tho' not as to the quantity and bulk of them.

Physicians are at some disagreement about the time of the formation of the Birth. HIPPOCRATES Lib. 1. de Carn. tells us that the Seed being received into the Womb, by the seventh day hath whatsoever it ought to have, and that if an Abortive at the end of this term, be put into the water, and accurately viewed, the rude draught of all the parts will be discernible in it. Others allow a longer time for this forming of all the Parts: ARISTOTLE Lib. 7. Hist. Animal. saith that the Body of the Birth on the fortieth day, consists, as it were, in a Membran, which being rent, the Birth appears of the bigness of a great Pismire, in which all the Members may be distinctly seen.

Now what this Plastick or formative virtue is that lies hid in the Seed, which begins and carries on the formation of the parts, all are not agreed. GALEN sometimes calls it Nature, sometimes Native Heat, sometimes the Inborn Temperament, and sometimes Spirit, which in his Book de Trem. & Vigor. he determines to be a substance

moveable of it self, and always moving. ARISTOTLE, Lib. 2. de Generat. Animal. Cap. 3. distinguishing betwixt the Heat or Spirit of the Seed, and Nature, saith that the Plastick Virtue, is the Nature that is in the Spirit of the Seed. AVICENNA and others following AVERROES call it a Celestial Power, or Divine Virtue. Some admit no other Soul in Man but the Rational, and maintain that it alone, out of convenient seminal matter offered to her, doth perfect all the Lineaments of the parts, and that she is the Architect of her own House. Others affirm that there is a Vegetative or Vital Soul in Man, which is Mortal and distinct from the Rational, and that this Soul is the chief, yea sole Operator in the forming of the Birth, and the very same which some call the Plastick or Architectonick Virtue.

The Antients differ also, as to what parts of the Body are first formed. ARISTOTLE was of opinion that the Heart was first formed, as being the Fountain of Heat, and the Principle of the Animal Life. For it seems very consonant to Reason, that what dies last, should have the precedence in formation. Others suppose that all the parts of the Birth are formed at once, and contend that there is no reason why the Heart should have any such Præeminence allow'd it. For why, say they, should the Heart be formed before the other parts, seeing that in the framing of the Members, the Birth doth no more stand in need of the Influence of the Heart than of the Sense of the Brain? Nature digests the whole Mass of the Seed with one and the same Heat, which equally penetrates all the parts of it; so that when she begins to frame a Body, she doth not confound the particles of the Seed, but distributes them all into their several places. Which distribution of the Seed cannot consist with a successive Generation of Parts; seeing it is equally requisite, that a part fit to form the Brain should be taken from the Heart, as it is that the Brain should communicate a part proper to constitute the Heart: Besides, Nature might be accused of Impotence, if she could not perfect and compleat those things together at once, which she hath begun at once.

Neither is it contradictory to this assertion, that some parts appear to us before others, because this is only to be attributed to their greater bulk. For the greater parts seem by Nature to be before the less; but we cannot therefore infer from hence that they exist before them; because all the Members of the Body are not perfected and compleated at the same time, but according as they are more or less nourished or heated. Wherefore HIPPOCRATES Lib. 1. de Dieta saith that all the Members are distinguish'd and encrease together; not one before or after the other; tho' those parts which be greater by Nature than others, do appear before the lesser, but do not exist before them. For the order of Nature is, that the more worthy parts, and those that are designed for the use of others, should appear first, and therefore it is that the upper parts appear before the lower, and those which are formed of the Seed, before those that are formed of the Blood. But yet it sometimes happens, that the more imperfect parts are framed before others, as is manifest in the Navel, which is perfected before either the Heart or Brain.

VIII.
What Parts
of the Body
are first
formed.

IX.
All Parts
of the Birth
are formed
together,
notwith-
standing
that some
parts be
seen before
others.

This

V.
How the
first Rudiment
of the
Birth comes
to be like
Man.

VI.
The Time
of the For-
mation of
the Birth.

VII.
What the
Architecto-
nick or Pla-
stick virtue
is.

X.
This fur-
ther proved
from a
Chicken.

This may be proved by Experience; because never was there any Birth found, in which the Heart or any other part was formed, before the other parts were framed also. For tho' in the forming of a Chicken, about the fourth day, the Head and Body of the Chicken begin to appear, when neither Wings or Legs are yet distinguishable, yet even at that time the Rudiments of those parts are there, tho' so little as not discernible by the bare Eye. And thus much concerning the opinion of the Antients about the forming of the Fetus.

XI.
Dr. HARVEY's opi-
on concern-
ing Con-
ception.

Dr. HARVEY was the first of Modern Authors who maintained, that the Masculine Seed did not concur to the constitution of the Birth; because in the many Animals he dissected after Copulation, he never found any Seed in their Wombs, and therefore was induced to believe, that the Seed of the Male did never reach the hollow of the Womb, or if it did, that it never staid there, but soon after slipt away: and accordingly he supposed that the Male-seed, only by a prolifick breath or contagion, doth make the Female conceive. Secondly, That the Natural Conception in the Womb, happens much in the same manner, as doth the Animal Conception in the Brain: for as we, after having framed an Idea in our Brain, do express the likeness of it in our Works; so likewise the Idea or Species of the Begetter, tho' the Geniture or Seed be absent, by the help of the Formative Faculty, doth beget a like Birth, by impressing the Immaterial Species it hath upon its work.

XII.
How Con-
ception is
performed
according
to Steno,
and other
later Phy-
sicians and
Anatomists.

In the year 1670, STENO a famous Anatomist, discovered that the Female Testicles so called, are nothing else but Ovaria, that is, Receptacles of Eggs, which hath been since confirmed by the Writings of KERCKRINGIUS, SWAMMERDAM, GRAAF, GASPARD BARTHOLINUS and others. And accordingly the received opinion now is, that the Birth, with all its parts, lies hid in these Ovaria, tho' not to sensible appearance. And therefore maintain that the Birth is not formed of the Seed, but that the most Subtil Spirit only of the Masculine Seed is conveyed through the bottom of the Womb and the Tubes or Trumpets (so called by FALLOPIUS for their resemblance with that Instrument) to the Female Ovarium, where it impregnates one of those little Eggs, that is, causeth or excites a Fermentation in it, which makes the Egg to swell, and to require a greater space, by which means it cracks the common Membran of the Ovarium, and through the slit of it, is driven into the Fallopian Tubes by those shaggy edgings which are at the end of the said Tubes, and by Anatomists are called the Leaf-work Ornament, being blown up and distended by the Animal Spirits, and which at the time of Copulation, like so many Fingers, clasp themselves about the Ovarium; and thus the Egg is conveyed through the whole length of the Fallopian Tubes to the bottom of the Womb, where it is further hatched into a Living Birth.

XIII.
The Point
illustrated
from a si-
militude
betwixt the
Vegetation
of Plants
and Ani-
mals.

The Learned Mr. RAY illustrates this matter in his History of Plants from the Analogy and similitude there is between the Vegetation and encrease of the Seeds of Plants in the Earth, and of Viviparous Animals in the Womb. For even as, saith he, the ripe Seed of a Plant falls down to the Earth, and being there free and at liberty, doth first of all attract the Aliment through the pores

of its coverings, and afterwards shoots down roots into the Earth; so likewise the Egg of a Viviparous Animal, being by the Masculine Seed made Fruitful, and brought to Maturity, falls down from the Ovarium as from its Tree, into the Womb, as the Earth, where continuing for some time loose and at liberty, without being fastned to the Womb, it takes in its first Aliment through the involving Membrans or Secundines. These Ovaria are nothing else but the Female Testicles formerly so called, which he that diligently views will find them to be nothing else but a Cluster of little Eggs.

Admitting this opinion, we may easily resolve the following Difficulties, according to SWAMMERDAM in his Miracle of Nature, or the Structure of a Womans Womb. First, Why a Parent that wants Arms or Legs may notwithstanding propagate a Birth, perfect and compleat in all its parts; even because all the Parts of it are contained in the Egg. Secondly, So likewise that old and famous Question, whether the flowing of the Seed from all the parts of the Body be required to the perfection of the Birth, is readily answered. Thirdly, Hence it appears how Levi, long before his Birth, was said to pay Tenth's, in, or with his Great Grand-father Abraham to Melchizedek, to wit, because he was in the Loins of his Parents, as all the parts of an Animal are in the Egg. And Fourthly, Hence also may be explained and illustrated the ground and foundation of Original Corruption, because all Men that ever were, or shall be, were hid in the Loins of Adam and Eve, to whom therefore it may be easily conceiv'd, that that primordial Taint must have been necessarily propagated from these their First Parents.

Now as to the time of the Animation of the Birth, Authors are likewise at great variance. ARISTOTLE supposeth that a Male Body receives its Soul the 42d day after Conception, and a Female on the 19th. Whereas AENEAS GAZÆUS will have the Soul not to be put into the Body already formed, but into the Seed it self, whilst it is yet without Form. THOMAS FIENUS, in his Book de Format. Fetus, determines the Infusion of the Soul to be the third day. But if it be lawful to guess at a thing so obscure as this is, it seems most probable that the Soul is then joined to the Body, when it is furnished with all its Organs, that is, after the formation of the Belly, Heart, Brain, the Pineal Kernel, and all the other Parts, which Anatomists tell us happens about the Fourth Month.

XIV.
Many dis-
culties may
be solved
from this
Hypothesis.

XV.
At what
time the
Soul is in-
fused into
the Body.

CHAP. V.

How the Body of Man is nourished and encreased.

Forasmuch as those parts that are so turned into our Substances, as to preserve our Body in the same state and condition only, are said to nourish us; and that those parts, which being transmuted into our Bodies, do make it greater in Bulk than it was before, are said to encrease it, and make it grow, we may easily apprehend what Nourishment and Growth is.

I.
What Nourishment
and Encrease is.

The

II.
The Pro-
gress of our
Food from
our Mouth
to the Sto-
mach, Guts,
&c.

The manner how both these are performed will more plainly appear, by taking an exact view of the *changes* of those *Aliments*, whence the *Principles* of our *Blood* are derived. *First*, It is evident that, besides the *Culinary Preparation* of the *Aliment*, it is chewed by the *Teeth*; and being mingled with the *Spittle* is sent down into the *Stomach*.
2ly. That in the *Stomach* it undergoes a special *Fermentation*, whereby it is yet further dissolved.
3ly. That from this dissolved and digested *Mass*, by another peculiar effervescence or working in the *Guts*, are separated the more useful and pure parts of the *Chyle*, from those that are more thick and gross, which are yet farther dissolved and attenuated in the *Lacteal Veins*, and the *Kernels* of the *Mesentery*, as also by the Commixture of the *Lymphatick Juice*; and at last being mingled with the *Blood* in the *Veins*, are carried to the *Heart*; where having past another effervescence, they become united with the rest of the *Blood*, there being now no more any difference between them.

III.
How the
Chyle is
driven out
of the Sto-
mach into
the Guts.

When, I say, that the *Chyle* is driven out of the *Stomach* into the *Guts*, I do not thereby own any Expelling Faculty residing in the *Stomach*, as the *Antients* did suppose, this being done by the *Animal Spirits* flowing through the *Nerves* into the *Membrans* of the *Stomach*, and drawing them together. And forasmuch as these *Membrans* of the *Stomach* do immediately infold and embrace the *Chyle*, in a healthful state of the *Body*, the said *Liquor* must of necessity be expelled through the *Lower Orifice* of the *Stomach*, into the *Guts*, as is manifest from a *Bladder* filled with *water*, the neck of it being left open; for as soon as you press this *Bladder* with your *Hands*, the *water* gusheth out immediately at the *Neck*. Moreover, the pressure of the neighbouring parts, as of the *Liver*, *Spleen*, *Guts*, *Midriff*, the *Pancreas*, or *Sweet-bread*, and especially of the three last, contribute much to this Expulsion: for the *Midriff* is driven downwards by constant *Inspiration*, and pulseth upon the *Stomach* that lies under it, as may be seen in the cutting up of *Living Beasts*.

IV.
The nour-
ishing of
the Body is
performed
by the help
of the Blood

And forasmuch as it is observed that a *Body* cannot be nourished, as long as the *Blood* continually flows from it, but that on the contrary it wastes and consumes; we may well conclude, that *Blood* concurs to the *Nourishment* of the *Body*, and that it is a *substance*, which acquires another nature, so as to supply those parts that are dissipated, and turn to *Excrement*.

V.
The opinion
of the An-
tients con-
cerning Nu-
trition and
Growth.

Which Change the *Antient Physicians* explained, by saying, that when the *Blood* was come to the utmost parts of the *Branches* of the *Capillary Veins*, it sweat through them in the form of a *Dew*, which afterwards turned into *substance* not unlike to *Glew*, of a mean consistence; which *Glewy substance* was then attracted by the several parts of the *Body*, according to their several needs. So as that the *Flesh* attracted those *particles* that were most proper to be changed into *Flesh*; the *Bones*, the most fit to be turned to *Bones*; and that the same *Attraction* and *Assimilation* was performed by the help of 2 *Faculties*, the one whereof they called the *Attractive*, and the other the *Assimilative Faculty*.

VI.
This opini-
on rejected

But forasmuch as there is no such *Attraction* in our *Bodies*, and that our parts are not endued with any knowledge whereby they might be able to di-

stinguish such *particles* of the *Blood* as are like and fit for them, from those that are otherwise; this opinion seems to be very contrary to Reason. Neither do they make out, how the *Venal* and *Arterial Blood* comes to be changed into *Dew*, and thence into a *Glew*; neither can they demonstrate what those wonder-working *Attractive* and *Assimilative Faculties* are, they do so much talk of.

We say therefore, that the *Nutrition* of *Man's Body* is thus performed. The *Blood* being come forth from the *Heart*, wherein it hath received its utmost perfection, is driven towards the ends of the *Arteries*. For as soon as the *Arteries* become dilated, and as it were blown up, the small *particles* of the *Blood* they contain, run against the roots of some *Filaments*, which proceeding from the *Extremities* of the *Branches* of the *Arteries*, do constitute the *Bones*, *Flesh*, *Skins*, *Nerves*, *Brain* and the other solid *Members*, according as they are in themselves of a several *Figure* or *Texture*, and thus have the force to drive them a little forwards, and to take up their places. And then as soon as the said *Arteries* fall again, they leave the *particles* of *Blood* in the several places wherein they are, which abiding there, are by this means united to the part they touch. Now supposing this to be the *Body* of an *Infant* or a *Youth*, the matter whereof is very soft, and its *Pores* readily dilatable, if the *particles* of *Blood*, which are pushed out of the *Arteries* for the restoring of the solid *Parts*, be somewhat greater than those, into whose room they come, or if it happen that 2 or 3 *particles* crowd into one place, the *Body* by this means must needs grow and encrease.

But this apposition of *Parts* chiefly proceeds from the diversity of *Figures*, that is, as well in the several *Particles* of *Blood*, as in the *Pores* of the parts of the *Body*: for by this means it is, that when the *Blood* is driven into the *Parts*, some of the said *particles* are more fit to stop in these *Pores*, and others again in others; where being variously complicated and figured, they become immediately united with the *substance* of the *Parts*, and wholly changed into their nature: whereas those *particles*, which because of their peculiar *configuration*, are not fit to adhere or cleave to these or the other *Pores*, are driven further to others; till at last the residue of the *Blood*, whose *particles* were not adapted to enter any of the *Pores*, are remanded through the *Veins* to the *Heart*, there to be further digested, and to acquire a new *Aptitude* for their union with the several parts of the *Body*.

Yet we must not imagine that *Blood*, as it is *Blood*, doth nourish; for the *red particles* of *Blood* do not nourish our *Body*, but only the *Chylous parts* that are in it: for if the *Blood*, as such, did nourish our *Bodies*, then it must certainly perform this function to the *Heart* it self, and the *Lungs* which are so near to it; for the *Coronary Artery* of the *Heart*, as soon as it is got out from it, doth presently, by a retrograde motion, return to it again. Thus also in the *Lungs*, the *Blood* takes but a very short course. So that it cannot be otherwise, but that these 2 parts, must have the *Blood* dashing against them with more force, than it doth against any of the other parts of the *Body*: If therefore in any part *nutrition* were performed by the *Blood*

A a a

drop-

VII.
How Nutri-
tion and
Growth are
performed.

VIII.
How the
Parts of the
Aliment
become
changed
into Parts
of our Body.

IX.
Blood, as
Blood, doth
not nourish.

dropping out of the *Vessels*, the same must surely happen here, seeing that the *Blood* hath more force to enter upon them, by opening the small *Orifices* of the *Vessels*. But we do not see it does so in either of these parts; for we find the *Substance* of the *Heart* and *Lungs* in a natural and sound state, not moistened with extravasated *Blood*, but with a certain clear moisture.

Nay what is more, it is evident that the *Blood* never comes out of its *Vessels*, without causing some Disease or other; for if this happens in the *Lungs*, it causeth the *Spitting of Blood*, and if in other parts, *Swellings* and other *Diseases*.

X. The *Physicians* of old were of opinion that the *Chyle*, being by the *Branches* of the *Vena Porta* sucked out of the *Stomach* and *Guts*, were by them carried to the *Liver*. But our Modern *Anatomists* demonstrate that the *Chyle* is driven through the *Lacteal Veins* only to the *Subclavial*, and more particularly *GASPER ASELIUS*, in the dissection he made of a *Dog*, whom before he had ordered to be well fed, in the year 1622. which discovery hath been further improved by others, who have found that the *Lacteal Veins*, filled with a *Milky Juice*, are *Vessels* different from the *Mesaraick Veins*: forasmuch as in *Living Animals* they appear distinct from the *Mesaraicks* which are *Red*, if the dissection be administered 4 hours after the *Animal* hath been fed, that is, at the time when the distribution of the *Chyle* is made; for after that time they disappear again. But however tho' these be empty, they always appear like so many *Strings* or *Fibres*, and are never found fill'd with *Blood*.

XI. Neither doth the smallness of the *Lacteal Veins* in the least embarrass this opinion, for this was designed so on purpose by the Provident Care of *Nature*, to prevent the more gross and earthly parts of the *Chyle* from entering into them, as also that the *Chyle* through them might be, by degrees and leisurely distributed according to the necessity or requirements of the *Body*, and the more easily changed into *Blood* in the *Heart*, by that new disposition of parts it acquires by passing through it, and the Effervescence it undergoes there. For as the whiteness of *Snow*, and the colours of other *Bodies*, proceed only from the *texture* and *Position* of the *Parts*: So the *Blood* derives its *Redness* only from that position of *parts*, which it obtains by its frequent passing through the *Heart*.

XII. The Reasons that induce us to admit the use of the *Lacteal Veins* are; First, Because the *Chyle*, which is of a *White Colour*, cannot by the *Mesaraical Veins* be conveyed to the common *Ocean*, because they are manifestly filled with the *Blood*; whereas the *Lacteal Veins* are *white*, that is, of the colour of the *Chyle* that passes through them. 2ly. The *Lacteal Veins* do never appear till after the *Body* hath been fed, and only about the time when the food begins to be distributed; which is a strong argument to persuade us, that the *Chyle* passeth through them. 3ly. The quantity of the *milky liquor* that is in these *Veins*, may be increased, by pressing the *Guts*, whilst they are as yet full of *Chyle*.

XIII. The *Chyle* therefore being duly prepared, passeth through the *Guts*, where the *Alimentary Parts* are separated from the unprofitable and excremental,

and thence run into the *Lacteal* or *Milky Veins*, which carry the said *Liquor* into the *Common Receptacle*: From whence 2 other *Vessels* convey it through the *Thorax* or *Chest*, near the *Backbone*, up to the *Subclavial branches* of the *Vena Cava*, and there empty themselves.

Another Point to be examin'd is, how the *Birth* is nourished in the *Mother's Womb*; since it cannot take in its *Food* wholly by the *Mouth*, but at first rather by *Apposition*, and afterwards by the *Navel*. For the situation and disposition of its *Parts* will not admit of this, seeing that the whole *Body* lies crowded together, and hath its *Mouth* shut up between its *Knees*. And tho' as soon as it is born, it reacheth to the *Mother's* or *Nurses Breast*; yet is this only the effect of *Natures Providence*, which as it teacheth the *Birth* to fetch its *breath*; so likewise she directs it, where to meet with *Food*.

But that the *Birth* receives its Nourishment by the *Navel*, may be proved from the *Courses* of *Women*, which generally cease in those that are with *Child*, because the *Blood* is then defrauded of the *Chyle* and its *Nutritious Juice*, which at that time is kept in the *Womb* for the Nourishment of the *Birth*. And for the same Reason, as soon as the *Birth* is born, the *Breasts* are fill'd with *Milk*; because the *Juice* which before was employed to feed the *Birth*, mounts up to the *Breasts*, where it is changed into a *white Liquor*. And this is further confirmed by those *Women* who do not *Suckle* their *Children*, for these perceive the *Milk* to return from the *Breast* to their *Womb*, where it is evacuated. To which may be added, that if the *Birth* in the *Womb* were nourished by the *Mouth*, it seems that it should also *breathe*; which it is impossible it should do, as long as it is in the *Womb*. Yea further, should the *Infant* open his *Mouth* in the *Womb*, it would be in danger of being choaked with the *Liquor* wherein it swims. So that it is very probable, that the *Birth*, when it is perfected, is only, at least chiefly nourished by the *Umbilical Vessels*.

XIV. Now forasmuch as *Man* feeds on *Flesh*, *Fish*, *Herbs* and *Fruits*, it may be enquir'd which of these is his most *Natural Food*. Indeed if we examine the matter strictly, the feeding on *Flesh* doth not seem *Natural* to him; yea, if we consider the *Instruments* he makes use of in *Eating*, we shall find it contrary to the intent of *Nature*. For we find that those *Animals* that feed upon *Flesh*, as *Wolves*, *Lions*, and the like, have their *Fore-Teeth* long, sharp, and at some distance from each other; because *Flesh* cannot well be prepared for the digestion in the *Stomach*, without such *Instruments* as may pierce deep into the *Substance* of it, and pluck it to pieces. Whereas those *Animals* that feed upon *Herbs*, as *Sheep*, *Oxen*, *Horses*, &c. have short *Teeth*, which are ranged close together; whence it may be easily guess'd, that *Man* who is furnish'd with such like *Teeth*, was designed to feed chiefly on *Herbs* and *Fruits*.

XV. This is further confirmed by the Example of *Children*, who following the Instinct of *Nature*, do prefer *Fruits* before *Flesh*: For *Nature* not being as yet debauch'd in them, they manifest by their Choice, what *Food* she design'd for them. So that it is not to be question'd, but that if *Children*,

X. The *Chyle* passeth through the *Lacteal Veins*, to the *Subclavial*.

XI. The smallness of the *Lacteal Veins*, conduces much to the forming of the *Blood*.

XII. Why the *Lacteal Veins* are supposed to be of use for the Nourishing of the *Body*.

XIII. The passage of the *Chyle* from the *Guts*.

XIV. The *Birth* is not wholly nourished in the *Womb* by the *Mouth*.

XV. But by the *Umbilical Vessels*.

XVI. *Flesh* is not the *Natural Food* of *Man*.

XVII. *Children* love *Fruits* more than *Flesh*.

dren, as soon as they are weaned, should be kept from the eating of *Flesh*, they would the more strongly desire *Fruits*, and choose them before all other *Food* whatsoever.

XVIII.
The Eating
of *Flesh*
was un-
known to
the first
Men.

This Intent of *Nature* may further be illustrated from the Custom of the first *Men* that lived in the *World*, who fed only upon *Fruits*. And accordingly the *Holy Scriptures* assure us, that the eating of *Flesh* was not permitted till after the *Flood*. If it be Objected, that some *men* have been found in the *World*, that have fed upon *flesh*, as the *Savages of Brasile, &c.* it may be easily answer'd, that these did not follow the guidance of *Nature*, but their own depraved Lusts and Affections, which prompted them not only to the eating of *Flesh*, but even to the devouring of *Mans Flesh*.

XIX.
Nature de-
monstrates
the same,
by denying
us Instru-
ments ne-
cessary for
the Eating
of *Flesh*.

Moreover, had *Nature* intended *Flesh* to be our nourishment, she would without doubt have furnish'd us with *Instruments* fit for that purpose, nor have put us to the shift of making use of *Knives*, which other *Carnivorous Animals* do not stand in need of. Besides, why have we such an aversion to *Raw flesh*, and cannot endure to taste of it till it be prepared by *Fire*; but only to shew, that *Flesh* is not our *Natural food*, being only introduc'd by *Lust*, which hath quite changed our *Nature* from its *Primigenial Inclination* and *Temper*.

XX.
Man would
be every
whit as
strong, if
he liv'd
only on
Herbs and
Fruits.

Neither let any *Man* object here, That *Man* would be much weaker, if he should confine himself to feed on *Herbs* and *Fruits* only; for we see that *Horses* and *Bulls* are very strong and hardy *Animals*, which yet feed upon nothing but *Herbs*, and *Corn* or *Pulse*. How swift is a *Stag*, how lively vigorous and long Liv'd; and this only by feeding on the *Grass of the Field*? So that I should be easily induc'd to believe, that in case a *Man* were brought up like a *Beast* in the *Fields*, he would not be inferiour to *Stags* in running, nor to *Apes* in climbing of *Trees*; which his delicate and tender Education do now make him unfit for.

CHAP. VI.

How the Motion of the Heart, Arteries and Muscles, are performed in the Body of Man.

I.
What the
Heart, Ar-
teries and
Veins are.

WE may gather from what hath been said, that the *Heart* is nothing else, but a *Body*, consisting of *Musculous Fibres*, into whose *Substance* are inserted *Arteries*, *Veins*, *Nerves*, and *Lymphatick Vessels*. An *Artery* is a *Vessel* or *Pipe* proceeding from the *Heart*, fitted for the containing and conveying of *Blood*. A *Vein* is another sort of a long and round *Vessel*, hollow like a *Pipe*, with a single and lasting *Coat*, woven together of all sorts of *Fibres*. There are 2 *Veins* which proceed from the *Heart*, and in their coming out from it separate themselves, and are called by several Names: The *Vena Cava*, or *Hollow Vein*, proceeding from the *Right Ventricle* of the *Heart*, and from thence mounting strait to the *Brain*, is called the *Jugular Vein*, which under the *Armpits* divides it self into 2 *branches*, called the *Axillary Veins*, or *Subclavial*; and going downwards, it becomes also divided, and lends a large *branch* to the *Liver*; and this is the *Vena Porta*,

so called, which being divided into very small *branches*, loseth it self in the *Liver*. The other *Vein* being derived from the *Left Ventricle* of the *Heart*, is called *Pulmonalis*, or the *Lung-Vein*; because it is distributed through the *Lungs*, the use of it being to convey the *Blood* back from the *Lungs*, by means of the *Ear-lappet* of the *Heart*, into the *Heart* again.

We perceive many *motions* in the *Body* of *Man*, which the ignorant *Common People* do attribute to the *Soul*; for they seeing that a *Dead Body*, after the *Souls* departure, is deprived of all *motion*, conclude all *motion* to proceed from the *Soul*. But we shall easily be convinc'd of this *Errour*, by observing the *Nature* of *Flame*, which notwithstanding that it is *Inanimate*, is in continual *motion*; even to that degree, as to exceed the agitation that is perceived in *Animated Bodies*.

But not to concern our selves about the *Opinions* of the *Vulgar*, we conclude *Heat* to be the *Bodily Principle* of all our *motions*; seeing that *Death* is caused by nothing else, but the loss of our *Native Heat*, or the destruction of some *Principal part* of our *Body*. Wherefore when the *Soul* becomes separated from the *Body*, this doth not proceed from any defect of the *Soul*; but because the *Heat* vanisheth, or because some of the *Organs* are destroy'd and spoil'd. For as long as we live, there is a *Heat*, or rather *Fire* in our *Hearts*; but such a one as is without *Light*, (and not much unlike to that whereby new *Wine* grows hot and ferments) which we make the *Principle* of all the *motions* that are in the *Body*.

There be 2 *Ventricles* in the *Heart* FF, to which 4 *Pipes* or *Channels* do answer: To the *Right Ventricle* GG, the *Vena Cava* AB answers, into which all the other *Veins* empty themselves, as into their common *Receptacle*; and the *Arterial Vein* D, which proceeding from the *Heart*, divides it self into divers *branches* in the *Lungs*. To the *Left Ventricle* HH, as many *Channels* do belong, viz. the *Venal Artery* E, which riseth from the *Lungs*, and the *Great Artery* called also *Aorta* C; which being derived from the *Heart*, doth divide it self into many *Rivulets*, throughout the whole *Body*.

They who are acquainted with the *Works* of Dr. HARVEY, know that the *Blood* runs out of the *Vena Cava* AB, into the *Right Ventricle* of the *Heart* GG, and from thence is carried to the *Lungs* through the *Arterial Vein* D; and afterwards returns from the *Lungs* into the *Left Ventricle* of the *Heart* HH, through the *Venal Artery* E; and last of all, after these *Circulations*, is conveyed into the *Great Artery* C, which carries the *Blood* throughout the whole *Body*. These things being explained thus in few words:

I say, That the *motion* of the *Heart* proceeds from the *Dilatation* of the *Blood* that passeth through it; Which effect of *Dilatation* is to be ascribed to the *Fire* which lies hid in the *Heart*, which rarefies the *Blood* as soon as it enters into the *Ventricle* of it; by which rarefaction and expansion of the *Blood*, the *Mouths* of the *Vessels* are opened, and the *Blood* is conveyed thence; upon which evacuation other *Blood* enters the *Heart*, to supply the place of that which is run out; which rarefying in like manner causes the

II.
All Motion
in Man,
doth not
proceed
from his
Soul.

III.
Heat is the
Cause of
all our
Motions.

IV.
Of the
Parts of
the Heart.

Figure
62.

V.
The Blood
runs
throughout
the whole
Body.

VI.
The Cause
of the
Motion of
the Heart,
is the
Bloods di-
latation.

Heart to swell. And from this only proceeds the motion of the Heart and the Pulse or beating of the Arteries; which is as often repeated, as any fresh Blood enters into the Ventricles of the Heart.

VII.
There is more Heat in the Heart, than in any other part of the Body.

For we are to observe, that as long as an Animal lives, there is more heat in the Heart, than in any other part of the Body; as also that the Nature of the Blood is such, as that upon the least overheating, it becomes immediately dilated and rarefied, whence the motion of the Heart and the Pulse of the Arteries do proceed.

VIII.
How the Heart and Arteries are moved.

For the better understanding whereof, we are to observe that the Pulse or Beating of the Arteries is chiefly promoted by 11 little Skins, which like so many little Floodgates or Doors, do open and shut the Orifices of the 4 Vessels that answer to the 2 Ventricles of the Heart. For at the same moment that one of these Pulses ceaseth, and another is at hand, these Valves in the Orifices of the two Arteries are exactly shut, and those that are in the Orifices of the 2 Veins are opened; so that it cannot be otherwise, but that at the same time 2 parts of Blood must run out of these Veins, one into the one, and the other into the other Ventricle of the Heart. Whereupon these 2 portions of Blood, being both of them rarefied, and consequently taking up a greater Space, they shut the Valves that are in the Orifices of the 2 Veins, and so hinder any more Blood to fall down into the Heart; and at the same time do push against and open the Valves of the two Arteries, and swiftly rush into them, by which means both the Heart, and all the Arteries of the whole Body are blown up. But this rarefied Blood becomes presently condens'd again, or penetrates into other parts of the Body. And by this means the Heart and Arteries fall flat again, the Valves in the entrance of the 2 Arteries are shut up, and those that are in the Orifices of the 2 Veins are opened, and give passage to 2 other portions of Blood, which cause the Heart and Arteries to be blown up again.

IX.
The Heart and the Arteries beat at one and the same time.

Having thus discover'd the Cause of the Pulse, it may be easily conceiv'd that the Heart and Arteries must beat both together; for tho' Blood be a fluid Body, yet forasmuch as it is contained in the Veins and Arteries, it is to be consider'd as a Continuous Body. For as when one end of a Continuous Body, such as a Stick is, is moved, the other end is moved likewise, in the very same moment; in like manner a fluid Body that is contain'd in a Pipe or Channel, if any part of it be moved, the whole must needs be moved also: Which the Boys in their play do evidence, who whilst they push forwards the Water that is at one end of the Spout, they make it gush out at the other. Moreover, all the Arteries that are in the Body are continued and joyn'd together, and do all of them rise from the Aorta; so that upon the least determination of Motion that is impress'd upon this beginning of the Arteries, all of them must be made partakers of the same.

X.
The Animal Spirits derive their Original from this Cause.

From this Dilatation of the Blood in the Heart, the Animal Spirits take their Original. For seeing that the Blood is made of the Chyle, and that the Chyle is nothing else, but a company of the more subtil Particles of the Aliment that have been dissolved in the Stomach, separated by means of the

Orifices of the Lacteal Veins, and from thence carried to the Heart: It cannot be question'd, but that the Chyle and Blood, by frequently passing through the Heart, must attain to that great degree of Subtility, as to resemble the Particles of those Bodies, which the Chymists, after fermentation, and several digestions and cohobations, do distill into Spirit, and bring over the Helm. These Spirits move upwards towards the Brain, because the Great Artery G, by which the Blood is carried up out of the Heart, tends directly that way. But being in great quantity, and not all of them alike pure, the more Subtil of them only do enter the Brain. So that the Animal Spirits are the purest portion of the Blood, subtilized by the heat of the Heart, and of that extream Swiftnes, as to resemble the volatile Particles of Flame. For the Spirits are in a continual agitation, and never cease from Motion.

Now in order to our understanding of the manner how our Members are moved, we are to take notice, that the Nerves, which are the Conduits of the Spirits, do proceed from the Brain and the Pit of the Back-bone, and end in many strings or filaments, which penetrate into the fleshy part, and help to constitute a Muscle: For these 2 Parts, viz. Flesh and Nerves do chiefly constitute the Essence of a Muscle. Which appears from hence, that many Muscles are found in the Body, in which nothing else is to be seen, besides the Nerve and the Musculous flesh; as the Muscles of the Eyes, Forehead, Temples, Bladder, &c.

The Muscles therefore are parts of the Body, that are fastned to others more solid, consisting of a loose and porous Flesh, and of a Membran that surrounds them; which, when the Nerves do reach, (to make use of the words of GALEN, Lib. 1. de motu Musculorum, Cap. 1.) they become variously cut and divided, till at last being altogether scattered into thin and skinny Fibres, they are woven through the whole body of the Muscle, &c. For the Nerves are no other than so many Channels, which convey the Spirit, and are endued with Pores and Valves, that open themselves towards the Cavity of the Muscles; so as that when once the Spirit is let in, they do hinder it from returning back again. It is necessary therefore, that the Muscles being blown up by the Animal Spirits, should be dilated in breadth, and contracted in length, and thus move the part to which they are fastned by way of Traction or Drawing.

The Muscles which GALEN, calls the Instruments of Motion, are all of them alike; but differing in quantity, situation, and figure. With respect to their Dimension some are Thick, as the 2 that are called Vast ones; others Thin, as the slender Muscle that bends the Leg or Shin-bone. Some are Long, as the strait Muscle of the Abdomen, and the Abductor of the Leg; others Short, as the Pyramidal Muscles at the bottom of the Abdomen. Some Broad, as the oblique and transverse Muscles of the Abdomen; others Narrow, as the Muscles of the Fingers and Toes. As to their situation, some are on high, others below; some on the Right-hand, others on the Left, &c. As to their figure, some resemble a Lizard, others a Thorn-back, others a Mouse: Some are three-corner'd, some four, some five; others are Round, Pyramidal, and the like.

There

XI.
What Parts of a Muscle doth constitute it.

XII.
What Muscles are, and how they come to be stretched, and swell.

XIII.
The Difference of Muscles, as to their Situation and Figure.

XIV.
The Parts
whereof
the Muscles
do consist.

There are 3 Parts commonly assigned to a Muscle, the Head, Belly and Tail: By the Head of the Muscle, Anatomists understands that end, towards which the Contraction tends. Most Muscles have but one Head, tho' there be some that have two, and others three. By the Name of the Tail, they understand that end of the Muscle which is inserted in the part that is to be moved. And by the Belly they denote the middle part of the Muscle, which appears more swell'd like unto Flesh. Some Muscles have but one Belly, others two; as the Muscle which shuts the lower Jaw-bone, and that of the Bone Hyoides, which are therefore called Double-bellied Muscles, as those that have three Bellies are called Three-Bellied.

XV.
A description
of the
Half Ner-
vous Mus-
cle.

This may happen several ways, the first whereof is, when the fleshy Fibres of 2 Muscles do directly meet one another, and by this means form one Tendon; as it happens in the Muscle called Semi-nervosus, or Half-sinewy, which is represented by the Figure, in which the fibres of the 2 Muscles A B, and B C, meeting one another directly, do by this their meeting form one common Tendon E B.

Figure
63.

XVI.
The descrip-
tion of a
two-headed
Muscle.

The second manner is, when the Fibres of 2 or more Muscles, meeting each other obliquely, confound their Tendons, and of 2 make 1; as it happens in the Two-headed Muscle of the Arm, as also in the Deltoides, which are represented by the Figure, wherein the Fibres of the 2 Muscles A B, and D C, do meet obliquely, and confounding their 2 Tendons, make one of it, viz. the Tendon E F.

Figure
64.

XVII.
The Muscle
of the
lower Jaw-
bone.

The third manner is, when the Fibres of two Muscles falling upon the two opposite sides of one common Tendon, continue parallel to each other; as it happens in the Digastrick or Two-bellied Muscle, which moves the Lower Jaw-bone, and which is represented by the Figure, in which the Fibres of the Muscles D C, and B A, falling upon the two opposite sides of the Tendon F E, continue in a Parallel position to each other.

Figure
65.

XVIII.
The Mathe-
matical
effect of a
Muscle.

There are some modern Philosophers, who endeavour to make out, that the effect of any Muscle is merely Mathematical, and demonstrable from the Principles of that Science. For seeing that there is a threefold Dimension, viz. Length, Breadth, and Depth, and that the figure of a Muscle is terminated by these, it follows, that all Muscles, that lye upon the Bones, when they are contracted, do increase as much in breadth and depth, as they lose in length; that is, attain to a greater prominence of their Bodily bulk; whereas, when they are extended, they cover a greater part of the Body. Which they demonstrate thus: Let there be a Parallelogram A B C D, representing the Two-headed Muscle in its state of Extension, and the Square B E G F, equal to it, representing the said Muscle in its state of Contraction. They say, that the Contracted Muscle in the second Figure, is every whit as large as the Extended Muscle in the first Figure: And because the Square of the Muscle B E G F, is equal to the Parallelogram A B C D, therefore they infer, that the surface of the Muscle is the same in both of the Positions, and that the Part G D, changed into breadth, is proportion'd to the Line A D, which determines the Local motion.

Figure
66.

The motion therefore of our Members is owing to the Muscles, which is when some of them are Contracted, and others Extended; for no part of the Body can be reduc'd to a less Extension, but that at the same time it must draw up to it that part to which it is joyned. Now that one Muscle is rather contracted than another, proceeds from the Communication of Spirits. For that Muscle is contracted that hath most Spirits, as there are fewer Spirits in that which continues extended, and for this Reason appears longer and thinner.

When it is said, That the Spirits which proceed from the Brain, do assist the motion of the Muscles; this is not so to be understood, as if they alone were sufficient to perform this, but that they determine the Spirits that are contained in all the Nerves of our Body, to tend to one part, more than towards another; or because they open the Orifices, through which many other Spirits may flow to one part, and by blowing up the same contract it.

From whence we may gather, That our Soul doth not immediately move our Members, but only direct the Spirits that flow from the Heart, through the Brain into the Muscles, and determine them to such and such motions. For the Spirits are indifferent of themselves, and may with the same facility be applied to several Actions. Wherefore all motions that are performed in us, without the command of our Will; as Walking, the Concoction of our Food, Singing, and other such like Actions, which are done without our advenience, are not performed by the Soul, but only proceed from the disposition of our Organs, and influence of the Spirits. So that all our Actions, our Thoughts only excepted, do agree with and resemble those that we see in Brutes, and have one and the same Principle.

C H A P. VII.

Of the Circulation of the Blood.

From what hath been now said, no small difficulty ariseth; viz. if the Blood flow out of the Vena Cava into the Right Ventricle of the Heart, and from thence into the Arterial Vein, and out of it into the Venal Artery, and thence into the Left Cavity of the Heart, until it rush out into the Great Artery; whence then shall we suppose, that such great store of Blood can be furnish'd? Or, how comes it to pass, that the rest of the Veins that empty themselves into the Vena Cava, are not exhausted? Or, that the Arteries are not over distended, into which the Blood from the Heart runs?

This Difficulty will disappear, if we consider that the Veins and Arteries are like so many Rivulets in our Body, in which the Blood runs along, beginning its motion, as hath been said, from the Right Ventricle of the Heart, and after various windings falling into the same again; so as that its motion is nothing else, but a continual Circulation. For the Blood which is contained in the Arteries and Veins of the whole Body, by turns continually rushing forth from the Heart, is driven along through the Arteries into the Veins, and out of

B b b b

them

XIX.
Our Mem-
bers are
moved by
the help
of the
Muscles.

XX.
The Spirits
that are
contained
in the
Nerves, are
assisting to
the motion
of the
Muscles.

XXI.
The Moti-
ons that
are ex-
cited in us
without
our adver-
tence, do
not pro-
ceed from
the Soul.

I.
How the
Blood is
carried
throughout
the whole
Body.

II.
The Veins
and Arteries
are like so
many Ri-
vulets in
the Body.

III.
The Con-
traction of
the Arte-
ries, pro-
motes the
motion of
the Blood.

IV.
Reasons
proving
the Circu-
lation of
the Blood.

V.
Nutrition
cannot be
performed,
without the
Circulation
of the
Blood.

them again returns into the *Vena Cava*, the Branches whereof are dispersed throughout the whole *Body*.

The Spontaneous Contraction of the *Vessels*, which are full of *Blood*, doth very much promote that vehement force, whereby the *Blood* from the motion of the *Heart*, is driven all along through the *Arteries* and *Veins*. For by means thereof, with the help of *Subtil matter*, which forceth the narrow *Pores* of the *Fibres*, the sides of the *Vessels* come nearer together, by which means the *Liquor* contained in them is still driven further, and runs with a greater Force, as coming from a larger Space which it hath near the *Heart*, into the narrower *Arteries*: According as we see it happens in a *Hogs-Bladder*, which being fill'd with the *Breath* that is blown into it, is no sooner removed from the *Mouth*, but the Spontaneous Contraction of the Sides of the *Bladder* do drive out the greatest part of the *Air*.

This *Circulation* was first discover'd by *Anatomists*, from the communication there is between the *Heart* and the *Lungs*. For they found there was the same quantity of *Blood* in the *Venal Artery*, as in the *Left Ventricle* of the *Heart*, which they concluded could not be so, except that the *Blood* were strained through the *Arteries* into the *Veins*, not by the *Anastomoses* or *Inoculations* of the *Arteries* and *Veins*, but by means of the *porous Substance* of the *Solid Parts*. They observed also, that in the *Hearts* of *Fishes* which want *Lungs*, they could not find a *Left Ventricle*, because there is no necessity in them to have the *Blood* transfused out of the *Heart* into the *Lungs*. But they clearly make out, that such a *Circulation* is necessary in *Man*, as well to preserve the *Heat* of his *Body*, as to the production of the several *Humours* thereof. For how could it be otherwise, but that the outward parts of the *Body* must be congealed with *Cold*, if *New Blood* did not continually come to them, communicating the *heat* it brings along with it from the *Heart*? For conceive we the *heat* that is in the *Heart* to be never so great, yet would it not be sufficient to warm the *Members* that are so remote from it, except *fresh Blood* did continually flow to them, to repair their lost *heat*. Yea, it could not be otherwise, but that the *Blood* which is *cold* of its own Nature, must needs *stagnate* and be *coagulated* in the *Parts*, in case it did not continually return to the *Heart*, there to recruit its *heat*, and borrow *new Spirits*.

Moreover, how could our *Bodies* be nourished, if the *Blood* did not continually flow to all the *Parts* of it? And except some *Particles* of the *Blood* passing through the ends of the *Arteries* became joyned to the *Body*, entering into the place of those which they juggle out? How otherwise could our *Food* be digested in our *Stomachs*, and turned into *Chyle*, if there were not a virtue in our *Stomachs* proceeding from the *Heart* through the *Arteries*, which did promote their dissolution? Moreover, all these Particulars may be confirmed from what before hath been said, concerning the Production of the *Spirits*, which being the most *Subtil parts* of the *Blood*, mount from the *Heart* to the *Brain* through the *Great Artery*, and being afterwards diffus'd into the *Muscles* by the help of the *Nerves*, impart motion to the *Body*. Which *Sallies* of the *Spirits* could not be, if the *Great*

Artery did not by a *Right Line* ascend from the *Heart* to the *Brain*.

To this also may be added the Practice of *Chirurgeons*, who when they go about to let any one *Blood*, make a *Ligature* about the *Arm*, above the *Orifices* of the *Vein*, towards the *Shoulder*, that the *Blood* may gush forth more freely; because the *Ligature* hinders the passage of the *Blood*, and doth not suffer it to pass beyond the *Ligature*: For tho' it cannot hinder the *Blood* from continuing its course, yet it cannot hinder but that *fresh Blood* still comes out of the *Artery* to the *Hand*, and from the *Hand* to the opening of the *Vein*; because the *Arteries* lye under the *Veins*, and by reason of the *Hardness* of their *Coats*, cannot be compressed without great Force. To which may be also added, that the *Blood* which proceeds from the *Heart*, through the *Arteries*, doth rush with greater force towards the *Hand*, than it returns from the *Hand* through the *Veins* to the *Heart*; because the *Blood* flows more slowly in the *Veins*, than in the *Arteries*; forasmuch as that which is in the *Arteries* hath but very lately been heated and rarefied in the *Heart*, whereas that which runs in the *Veins*, doth in time grow cold, and consequently moves more slowly.

In like manner therefore, as there is in the *Greater World* a continual Course of the *Waters* that return from the *Sea* through *Subterranean Channels*; and of those that run towards the *Sea*, by the *Rivers*: So in the *Little World*, *Man*, there is a perpetual *Circulation* of the *Blood* through the *Arteries* and *Veins*. The *Arteries* carry the *Blood* from the *Heart* to the *Members*; and the *Veins* return the same *Blood* again from the *Members* to the *Heart*: So that the *Circulation* of the *Blood* is nothing else, but the perpetual Motion of the same *Liquor*, passing from the *Heart* through the *Arteries*, and returning through the *Veins* to the *Heart*.

You will Object, That if the *Blood* be circulated throughout the whole *Body* 100 or 200 times (as some suppose) through all the *Arteries* and *Veins* to the *Heart*, there seems to be no reason why the *Blood* that is in the *Veins*, should be unlike to that which is in the *Arteries*; whereas we find it is so. For the *Arterial Blood* appears more lively and florid; whereas that of the *Veins* is more dull, and of a blackish Colour, which difference would not be, if the same *Blood* did run through the *Arteries* and *Veins*.

I Answer, That this difference of the *Blood* is, because that *Blood*, which is contained in the *Arteries*, hath before passed through the *Heart*, and keeps the same Qualities which it hath got there. Whereas the *Blood* that is contained in the *Veins*, is not so pure, as containing besides the *Blood*, which flows to them from the *Arteries*, another *Liquor*, communicated to them from the *Guts*. To which we may add, that the *Blood* is not so hot in the *Veins*, as in the *Arteries*; because the *Veins* are at a greater distance from the *Heart*, than the *Arteries*, which only is sufficient to make it very different from that which is in the *Veins*; because nothing is so easily changed, as the *Blood* is: As is evident in that as soon as it is got out of the *Veins*, the *Air* immediately corrupts it, so that it degenerates into another *Substance*.

It may be you'll Object in the *Second* place, that *Agues* only return at certain days; whereas supposing the continual *Circulation* of the *Blood*, they would

VI.
The Com-
mon Pra-
ctice of
Chyrurge-
ons, is a
confirmati-
on of the
Bloods Cir-
culation.

VII.
As in the
World there
is a conti-
nual motion
of the
Water; so
in Man, of
his Blood.

VIII.
Why the
Blood that
is in the
Veins, is
unlike to
that which
is in the
Arteries.

IX.
Answer.

X.
Whether
Agues do
depend on
the Motion
of the Blood.

XI.
Answer.

would recur more frequently, viz. as often as the Blood returns to the Heart.

To which may be Answer'd, That the Matter of *Agues* is not lodged in the *Veins*, according to the Opinion of some *Physicians*, but in some *Cavities* of the *Body*; where it continues till it comes to *maturity*, and be made fit to be mingled with the *Blood*. And according as it doth sooner or later arrive to this *Maturity*, it causeth either a *Quotidian*, *Tertian*, or *Quartan Ague*: And irregular *Agues* happen, when the said Matter, shut up in these *Cavities*, doth too much distend it self, and by its dilatation opens the *Pores*, so that by this means it wholly or in great part evaporates: For the *Pores* being once open'd, it is a hard matter to shut them again, before that much Matter is got out by them.

XII.
How long the Circulation of the Blood lasts in the Body of Man.

But some or other, it may be, will enquire, how long this *Circulation* lasts?

I Answer, That this may in some sort be guess'd at from the *Quantity* of the *Blood*, which at every *Pulse* of the *Heart* flows into the *Great Artery*; and by determining the *Quantity* of *Blood* contained in the whole *Body*. For if we suppose that at every *Pulse* of the *Heart*, one *Dram* of *Blood* enters into the *Aorta*, out of the *Left Ventricle*, and do then take an exact account of the number of *Pulses*, we shall easily infer, that if these *Pulses* be 64 times repeated in one *Minute* (as it hath been observed in a *Man* of a middle Age and *Temperament*) there will be 3840 of them in one *Hours* time. Whence it follows, that every *Day* 32160 *Drams* of *Blood* pass through the *Ventricles* of the *Heart* in one *Day*, which added together make 700 *Pounds* of *Blood*. But since there is not so much *Blood* in the *Body* of *Man*, nor scarcely above 10 *Pounds*, we must conclude that the whole *Mass* of *Blood* circulates through the *Heart* 72 times every *Day*, and that consequently it passeth out of the *Heart* into the *Arteries*, and from the *Arteries* to all the *Parts* of the *Body* thrice in one *Hours* time.

XIII.
How the Blood Circulates in the Birth, whilst it is yet shut up in the Womb.

It remains now, that we explain how that the *Circulation* of the *Blood* through the *Heart* is performed in the *Birth*, whilst it is shut up in the *Womb*: For seeing that the *Infant* doth not breathe in the *Womb*, as shall be said in the next *Chapter*, its *Lungs* lye still without motion, and consequently admit no *Blood* at all. There are therefore 2 *branches* found in the *Birth*, by means whereof this Defect is made up: The former whereof springeth from the *Vena Cava*, 2 or 3 *Fingers* breadth above the *Midriff*, and is inserted into the *Vein* of the *Lungs* near the *Left Ventricle* of the *Heart*, which the *Blood* presently enters, and after its *Fermentation*, or *Efferescence* there, is through the *Aorta* distributed throughout the whole *Body*; but the remaining portion thereof ascends farther through the *Vena Cava*, and enters the *Right Ventricle* of the *Heart*; from whence, after *Fermentation*, it proceeds into the *Artery* of the *Lungs*, out of which, near to its egress out of the *Heart*, another small *Channel* ariseth, which runs strait to the *Great Artery*, and into it pours forth the *Blood* that comes from the *Right Ventricle* of the *Heart*, to the end it may be distributed throughout the whole *Body*. So that because the *Blood* cannot pass through the *Lungs*, therefore that which enters the *Left Ventricle* of

the *Heart*, passeth into the *Right*; and thus by these *Channels*, the want of the passage through the *Lungs*, is made up. But after that the *Child* is born, these 2 *Channels* are stop't up, as being of no further use; the *Circulation* of the *Blood* being now performed through the midst of the *Lungs*.

CHAP. VIII.

Concerning Respiration.

Forasmuch as the *Life* of *Man* consists in the continual *Motion* of the *Blood*, and an *Animal* is said to live as long as the *Alimentary Juice* runs through the *Heart*, and from thence is driven to the other *Parts*; it is apparent that *Respiration* is necessary for the maintaining thereof, without which neither the *Beating* of the *Heart*, nor the *flowing* of the *Blood* can be performed. Hence it is that we commonly use the word *Expiring* for *Dying*; and that *ARISTOTLE* declares, that the *Life* of *Man* consists in the drawing and breathing out of the *Spirit*. For seeing that the *Heart* is heated by continual motion, *Respiration* is necessary for the *Ventilating* thereof, and for the *Cooling* of the *Blood*, to prevent it from being over-heated or inflam'd. *Respiration* therefore is the *Alternative Expansion and Contraction* of the *Thorax* or *Chest*, by which the *Air* is conveyed through the *Wind-pipe* to the *Lungs*, as well to cool the *Blood* contained in the *Veins* thereof, as afterwards to expel the said *Air*, together with the smutty *Vapours*: The *Chest*, *Midriff*, and *Abdomen*, as so many *Muscles* assisting to this *Motion*.

Respiration is twofold, *Voluntary* or *Spontaneous*: *Voluntary* is that whereby the *Soul*, by its *Cogitation* and *Will*, determining the motion of the *Animal Spirits* into the *Muscles*, which serve for *Respiration* and *Expiration*, doth by turns enlarge and contract the *Breast*. *Spontaneous Respiration* is that which is performed by us when we are asleep, or think of something else, from the conformation of the *Nerves*, which assist *Respiration*; whereby the *Animal Spirits*, without any determination of our *Thoughts*, flow into the *Muscles*, design'd for *Inspiration* and *Expiration*.

There be 2 *Parts* that constitute *Respiration*, viz. *Inspiration* and *Expiration*. *Inspiration* is that *Action*, whereby the *Chest* becomes dilated upon the entrance of the *Air*: *Expiration* is that *Action*, whereby the *Thorax*, or *Chest*, becomes compress'd upon the Expulsion of the *Air*, together with the *Vapours*. So that the *Breast* derives its *Dilatation* and *Contraction* from this twofold *Motion*; its *Dilatation*, when its *Parts* are extended beyond its *Natural* amplitude; and its *Contraction*, when of themselves they return to their former *Natural* situation.

When the *Air* enters the *Breast* in *Respiration*, this *Motion* doth not proceed from the fear or admitting a *Vacuum*, neither must we imagine, that the *Air* of it self runs thither without being driven; but forasmuch as by the *Dilatation* of the *Breast*, the *Air* which is about the *Breast* and the *Abdomen*, is easily thrust out of its place, because of its *Fluidity*; neither is there any other place to receive that *Air*, but that which is made for it by

I.
What Respiration is, and that it is necessary for the maintenance of Life.

II.
Respiration is either Voluntary or Spontaneous.

III.
There be two parts of Respiration.

IV.
The Air doth not enter the Breast to avoid a Vacuum.

by the *Dilatation* of the *Breast*; by this means it comes to pass that the *Air* which is driven away by the *Breast*, doth push forwards that which is about the *Mouth* and *Nostrils*, and drives it down the *Wind-pipe* into the *Lungs*. And thus as much *Air* is driven into the *Lungs*, as the *Breast* and *Abdomen* by their *Dilatation* do thrust away from them; so that here must be conceived a whole Circle of moved *Bodies*, according to that *Axiom* of *Natural Philosophy*, that *Every Motion is performed Circularly*. Now that the *Air* enters into the *Lungs*, because it is driven away by the *Breast*, is manifest in a *Dead Body*, where tho' the *Mouth* and *Nostrils* be open; yet the *breath* doth not enter into the Hollow of the *Breast*, because there is no Cause by which the *Air* might be driven thither. And the same we our selves experience, when after having breath'd out the *Air*, we keep our *Chest* for some Moments contracted: For in this state we are very sensible that the *Air* doth not in the least press upon us to enter into our *Lungs*, as long as we keep our *Breasts* in that posture.

V.
Respiration is performed by the help of the Muscles of the Chest, and the Abdomen.

Figure 67.

VI.
The manner how Spontaneous Respiration is excited at first.

VII.
The Reason of Spontaneous Expiration.

Respiration therefore is performed by the *Action* of the *Muscles* of the *Chest* and the *Abdomen*, which by extending and contracting of our *Body*, determine the *Air* to its *Ingress* and *Egress*. For there be 2 *Muscles* H and L, which by turns are blown up by the *Animal Spirits*, and fall again, and which by their *Ingress* and *Egress* do continually maintain the *Dilatation* and *Contraction* of the *Lungs*: For they are so disposed, as that when the one of them, *viz.* H is blown up or swells, the Space wherein the *Lungs* are contained, becomes dilated, whereupon the *Air* enters into them through the *Mouth* and *Nostrils*; and whilst the other L swells, the said Space is compressed, and then the *Air* is thrust out by the same ways: In like manner as the *Air* enters into a pair of *Bellows*, when the sides thereof are distended, and upon their being closed, is driven out again.

The *Animal Spirits* therefore being conveyed out of the *Ventricles* of the *Brain*, through the interposed *Pith* of the *Back-bone* into 2 *Nerves*, through the *Valves* C D, are sent in more abundance, and with greater force into the *Nerve* C G A, which serves for *Inspiration*; forasmuch as the same is supposed to be more large and open. And thus the *Valve* or *Flap* G, being in the midst of both *Nerves* is shut, and hinders the *Animal Spirits* from removing out of the *Muscle* H, into another passage K; and at the same time the other *Valve* F, of the opposite *Nerve* D F B, is opened, by which the *Spirits* pass out of the *Muscle* L, into the *Muscle* H; which together with those which flow from the *Brain* into the *Nerve* C G A, do enlarge the *Body*, and drive the neighbouring *Air* into the *Lungs*.

And thus is *Respiration* performed, and lasts as long as the *Muscle* H, being swell'd by the affluence of *Animal Spirits*, doth hinder the *Ingress* of other *Spirits*, and being straitened by the *Membran* 1, 2, 3, wherewith it is covered, as well as by its *Spontaneous Contraction*, is compressed to that degree, that the *Animal Spirits* rushing forth, by reason of their too great quantity, out of that *Muscle*, do open the *Valve* G, and passing through it into the *Muscle*, they together with other *Spirits* flowing from the *Brain* dilate it, and streightning

the *Breast* expel the *Air* out of it. And after this manner it is, that *Spontaneous Respiration* and *Expiration* is performed in us, either when we are asleep or awake.

But forasmuch as the *Lungs* have neither *Fibres* nor *Muscles*, without which no part of the *Body* is moved, we are to enquire what that is which effects this *Rising* and *Falling* of the *Lungs*. For as a pair of *Bellows* is distended or compressed with the *Hand*; so a like Cause must be assigned, which dilates and compresseth the *Lungs*: This upon Enquiry we shall find to be the *Midriff*. For it is a thing whereof every one is aware, when he feels that motion whereby his whole *Abdomen* is lifted up at every *Inspiration*, that at an equal Interval of time, the *Gristles* of his *Ribs* are drawn inwards; because the *Midriff*, by its middle part, presseth the *Stomach* and *Guts* downwards, and at the same time doth attract or draw inward, the *Gristles* to which its Extream parts are fastened, by reason of the *tension* or stretching of its Middle part. Moreover we find, that when we have fed plentifully, our *Respiration* is more swift, but withal not so strong and vigorous: And the same thing we Experience, when the *Air* we take in is thick and fill'd with gross *Vapours*. Forasmuch as in the former case, the *Midriff*, because of the over-fullness of the *Stomach*, cannot dilate it self, as it was wont to do, and therefore endeavours to compensate the diminution of this *Dilatation*, by the frequency of her *Respirations*. And in the latter case, the *Lungs* are so clog'd with the gross *Air* they have drawn in, that not being able to cast it out again, they are forc'd to continue distended; and so it happens that the *Midriff*, not being able to return to its first State, is put upon a more frequent *Reciprocation* of its Motion.

This may be further confirm'd from *Wounds* of the *Chest*: For as soon as that is pierced, immediately the *Lungs* fall flat, the *Midriff* still continuing its motion upwards and downwards, and attracting the *Gristles*, and moving them, as it did before the said *Wound* was inflicted: So that we cannot say, that the *Lungs* do perform the Function of *Respiration*, but that they are only as *Concomitants*, inasmuch as complying with, or following the motion of the *Midriff*, they take in the *Air*, and presently after being contracted, expel the same, together with the smutty *Vapours* that arise from the *Blood*. Yea, it hath often been observ'd, that some Men who have had their *Lungs* in a manner wholly consumed; yet have never been troubled with any considerable difficulty of *Breathing*; which could never have been, in case the *Lungs* were the principal and primary Instrument of *Respiration*.

Many are the Uses of *Respiration*: First, For the *Cooling* of the *Blood*; for except the *Blood* that flows from the *Right Ventricle* of the *Heart*, through the *Arterial Vein*, be refrigerated by the *Air* taken in by *Respiration*, and be condensed again, before it enters the *Left Ventricle* of the *Heart*, it cannot be fit Fuel to that *Fire* which lies hid in the *Heart*, nor maintain it.

The Second use is, That the *Air* which goes out from the *Heart*, carries along with it some *Particles*, which are as it were the *Smoke* and *Soot* of the *Blood*, and conveys the same through the

VIII.
The Midriff is the Primary Cause of the Motion of Respiration.

IX.
Wounds in the Chest prove the great influence the Midriff hath on Respiration.

X.
Of the manifold use of Respiration.

the *Arterial Vein*, from the *Right Ventricle* of the *Heart*. For the *Lungs* are as it were a *Sieve*, by the help whereof the *Filtb* is separated, and those *Humours* sent away which would choak the *Heart*, should they continue mingled with the *Blood*. *Respiration* therefore clears and purifies the *Blood*, that it may be fit to enter the *Left Ventricle* of the *Heart*, and without hindrance be transmitted to the *Aorta*. Wherefore *Respiration* is of absolute Necessity to the *Life of Man*, so that when that is stopt or hindred he must *dye*. And therefore *HIPPOCRATES* saith: *We may live for some days without Meat or Drink; but when once the passages of our Breath are stopt, we cannot continue one Hour. Moreover, when all other Actions admit Intervals of Rest, Respiration alone is that Action which in Animals never ceaseth.* For seeing that the *Animal Life* chiefly consists in the *motion* of the *Blood*, or at least necessarily depends on the same it is evident that upon the ceasing of *Respiration*, the *Blood* cannot pass from the *Right* to the *Left Ventricle* of the *Heart*; whereupon the *motion* of the *Blood*, which is of such absolute necessity to the maintaining of *Life*, must cease likewise.

If you Object here, That *Infants* live in their *Mothers Womb* without *Respiration*: I Answer, That *Nature* hath taken another way to secure the *Life* of the *Infant* in his *Mothers Womb*, by taking care that the *Blood* which hath been heated and rarefied in the *Heart*, should not any more return thither again, but in a very small quantity. For since the passage of the *Lungs*, because of their compact consistence, is intercepted or shut up, the *Blood* is conveyed another way, out of the *Right Ventricle* of the *Heart* into the *Left*, viz. through the *Body* of the *Vena Cava*, out of which there is a passage opened into the *Venal Artery*, which is commonly call'd the *Oval Hole*; and another out of the *Arterial Vein*, into the *Great Artery*; through which Passages the *Blood* is forced to take its course. But as soon as the *Infant* is born, the *Blood* enters through the *Artery* and *Vein* of the *Lungs*, either because these *Vessels* of the *Lungs* are wider than those other *Passages*, and afford it a more free Ingress; or because the *Passage* of the *Oval Hole*, and the *Arterial Channel*, begin to be obstructed by degrees, and turn to a *Ligament*.

And for the same Cause it seems, that *Ducks*, *Didappers*, *Geese*, and other *Aquatick Animals*, do live for some time under *Water*, without *Respiration*; because those *Passages*, I have but now mentioned, are not wholly stopt up in them, but either by their daily using of them, or by reason of the *Natural disposition* of the *Parts* in those *Animals*, do continue open, and cannot without some difficulty be obstructed or abolished. And we may with great probability attribute to the same Cause what *Historians* relate of some *Divers*, that would continue for *Hours* together under the *Water*, viz. that by a singular *Priviledge* of *Nature*, these two *Passages* continued open in them, so as that the *Blood* could pass through them, as it did before they were born. Yea, we have the *Relation* of some dissected *Bodies*, in which these have been found open, so as that the *Blood* could freely pass through them.

CHAP. IX.

Of the Growth and Decrease of the Body of Man; of the Temperaments and the Differences of Age.

A Body is said to be nourished, when the *Particles* of *Aliment* being turned into *Chyle*, do preserve and maintain it in the same state wherein it is; but it is said to grow, when these *Particles* are in such abundance joyned to it, as that thereby its *bulk* increaseth. Thus *Mans Body* is said to grow, when *Particles* of a new Substance are added to those which before made up its *bulk* or *magnitude*, exceeding in quantity what it loseth by continual *Transpiration*. For seeing that all the *Parts* of our *Body*, the *Bones* only excepted, are soft, their *Pores* consequently are easily dilat-able; and therefore whensoever more prepared *Aliment* is joyned to them, than their *Narrowness* can contain, consequently that *Body* must increase in *bulk*.

How this is done we shall easily understand, by following the *Blood* from its *Fountain*, the *Heart*, and observing the several turnings it takes in the *Body*. Conceive we therefore the *Blood* that hath been rarefied with the *Heat*, or *Fire* that is in the *Heart*, rushing forth thence through the *Aorta* towards the *Brain*, and some small portion of it entering the *Capillary Arteries*, and insinuating it self into all the infinite *Pores* of their *Membrans*, which are opened at every *Pulse* or beating of the *Heart*. Conceive we also these *Pores*, to be so exceeding narrow, that the *Particles* of *Blood* cannot range up and down in them, but are forced to pass strait forwards, so that touching one another, they do no longer compose a *Liquid Body*, but rather several slender *Threads*; such as the *Fibres* or *Strings* of *Flesh* are. This supposed, we shall easily apprehend that a *Body* is then said to be *Nourished*, when the dissipation of one *Fibre* of the *Flethy parts*, is made good by an equal portion of *Matter*; and to *grow* or *increase*, when more *Matter* is joyned to it, than was dissipated. As we see that *Bread* swells to a greater bulk, when its *Pores* take in more *Milk* or *Wine*, than the quantity of *Air* was, which either of these *Bodies* have driven out of them.

The *Decrease* or *Diminution* of the *Body*, is caused either upon the defect of *Food*, or when the *Aliment* is unfit to enter the *Pores*; or when the *Natural heat* is too weak to drive the *Food* to the ends of the *Fibres*, and by this means restore the dissipated Substance of the *Body*; as it happens in *Old Men*: Or when the *Heat* is too strong, as in those that are of a *Cholerick Complexion*: Or when the *Texture* of the *Body* is such, as that it cannot admit the *Alimental Juice* into its *Pores*.

The *Body* of *Man* is observ'd to grow till the years of 21 or 22; for seeing that until that term, the *Bones* are not yet arrived to their utmost degree of *Hardness*, and that the other parts of the *Body* are readily penetrable, the *Aliment* accordingly is readily received into the *Pores* of them; and though for many years after this, the *Body* may spread in *breadth*, yet at last it ceaseth from any further growth, because the *Parts* of the *Body*, by reason of a continual accesse of fresh

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Aliment

I.
How Aug-
mentation
or Growth
differs
from Nu-
trition.

II.
How Aug-
mentation
is perform-
ed in Mans
Body.

III.
What De-
crease or
Diminution
of the Body
is.

IV.
The Body
of Man
grows till
the Age of
One and
twenty.

XI.
How In-
fants
Breathe in
their Mo-
thers Womb.

XII.
Some Ani-
mals live
in the Wa-
ter, with-
out any
Respira-
tion.

V.
The Four
Tempera-
ments or
Complexi-
ons of a
Human
Body.

Aliment grow so hard in process of time, that its Pores can no longer be extended or dilated, nor any thing further be added to it.

The Body of Man being a compound of different parts, Physicians have attributed to it a Temperament consisting of several Humours, viz. Blood, Phlegm, Choler and Melancholy; which are distinguished by their native qualities. For the Blood in the Veins and Arteries is hot and moist; Phlegm cold and moist; Choler hot and dry; and Melancholy dry and cold. So that a Man whose Temperament is hot and moist, is esteemed of a Sanguine Complexion; he that is of a hot and dry, Choleric; and so of the rest. For all Men are not of the same Temperament, but differ according to the Predominance of one or more of these humours, and accordingly are inclin'd to various Passions and Inclinations.

VI.
The Dispo-
sition of
those that
are of a
Sanguine
Complexi-
on.

Persons of a Sanguine Temperament, have quick and lively Bodies, a Ruddy Colour in their Faces, they are little thoughtful or serious, but inclin'd to Jestings, Singing, Complaisance and all manner of Merriment; and much addicted to Lust and Pleasure. They have a great, full and moderate Pulse; which makes Youths that abound with Blood to be facetious, good natur'd, plump and of a Ruddy Complexion, and subject to Inflammations and other Diseases proceeding from a surplus of Blood.

VII.
The Temper
of such as
are Chole-
rick.

Choleric Persons, or such in whom the Gall abounds, are of a hot and hasty Temper, and like Straw or Stubble do easily take Fire, and are suddenly kindled with Anger and Indignation, but do not keep their Anger long, being soon reconciled. They are much subject to Tertian Agues, the Yellow Jaundise and Fluxes of the Belly, these Diseases proceeding from the Depravation of the Gall.

VIII.
The Melan-
choly Com-
plexion.

Those of a Melancholy Complexion are not so readily provoked to Anger; but being once provoked, are not easily appeased. They have a small and slow Pulse, narrow Veins, and a sad and dark Aspect. The diseases they are most subject to are Scirrhus Swellings, Quartan Agues, the Piles, Hypochondriacal Melancholy, and other Distempers of the Spleen.

IX.
The Phleg-
matick
Complexi-
on.

Phlegmatick Persons being of a cold and moist Temperament, are not troubled with any vehement Passions, neither are greatly moved about any outward things; and therefore are Slow, Sleepy, Lazy, and not at all inclin'd to be Angry: They are subject to daily Phlegmatick Tumours, Winds and the Dropsie.

X.
All the
parts of the
Body have
their Pec-
uliar Tem-
perament.

The parts of the Body also have their particular Temperament; for the Heart is the hottest of all other parts, as having in it a continual Fire, which is fed and maintained by the never-ceasing Afflux of the Blood. The most moist part is the Brain, which the continual Defluxions proceeding from it, are a pregnant witness of, being caused by those Vapours, which continually ascending to the Brain, are there condensed. The Bones are the most cold and driest parts of the Body, forasmuch as their particles are without all motion, and their Pores are only filled with Air or Subtil Matter.

XI.
Of the Dif-
ferent Ages
of Man.

The difference of the several Ages of Mans Life doth likewise depend on a variety of Temperament; and are more in Man than in other Animals. By the name of Age we understand such a

part of the Life of Man, wherein by reason of the mixture of Heat and Cold in his Body and their acting upon each other, the Temperament of it undergoes a sensible alteration. These Ages are distinguished into Childhood, or the Age of Stripling, the Age of Young Men, Manly Age, and Old Age.

The Age of Childhood in Boys reacheth to their 14th year, and in Girls to their 12th. The Bodies of Children are in a manner of an equal Temperature between Heat and Moisture; for tho' the Heat and moisture of their Bodies exceeds that of Men, yet they are said to be temperate, as being such as best agree with their state. BOYS and GIRLS begin to breed Teeth when they are a year and an half old; and when they are about 7, change their first Teeth for new ones.

The next Age is Youth, which extends to the 25th year. This Age is more Temperate than Childhood, as wherein the Heat doth not so much prey upon and dissipate the moisture, and the moisture less clogs the Heat. Youths are most desirous of Liberty, and accordingly as soon as they are got from under the Inspection of their Parents and Masters, they are apt to run into great Excess, by betaking themselves to their Lusts and Pleasures. As being persuaded that they are now wholly at their own dispose, and at full and absolute liberty to do whatsoever they please.

Next to Youth follows that which is called the Age of Young Men, which reacheth from 25 to 35, and is the flourishing Age of Man, wherein Heat and Driness do predominate; the watry Humour being much waisted in the foregoing years, and the Oily Particles more intricately mixed together, do make the Heat stronger, and preserve the Animal Spirits better. Accordingly Young Men are more hot than Youths, and violently carried to Venery. As to the Temper of their minds they are Restless, Rash and precipitant in their Judgment, neglecting present good things, and reaching out to those that are Future.

Next follows Manly Age, which from 35 extends it self to 50. In this Age the Natural Heat, and Agitation of the Spirits begins to be lessened; but yet the Body is not so exhausted, as that the natural Faculties grow faint and weak, seeing that every part is ready and fit to exert the Functions and Actions of Life.

Last of all comes Old Age which is Dry and Cold; the former part whereof called Viridis by the Learned, reacheth from the year 50 to 60, during which, many Old Men are yet pretty lively and vigorous; the Middle is from 60 to 70, during which term the Spirits are few and weak, and can but languidly perform their functions. The Senses grow dull and weak, the strength and vigor of the Body languisheth. And the last is that which is called Decrepit Age, which completing the Dryness and Coldness of the Body, brings in Death, the end and conclusion of them all.

XII.
Of the First
Age, Child-
hood.

XIII.
The Second
Age, Youth.

XIV.
The Third
Age, that
of Young
Men.

XV.
The Fourth
Age,
Manly
Age.

XVI.
The Fifth
and Last
Age,
Old Age.





To his Highness
Duke of



William
Glocester &c.^a

This Plate is most humbly
Dedicated by Richard Blome.

CHAP. X.

Of the Senses in General.

I.
What the
Senses are.

THO' all things in the *Body of Man* be full of wonder, and most proper to raise our minds in Gratitude to Glorify our Creator; yet doth nothing more lowly proclaim his Power and Goodness, than the variety of our Senses, which are those Affections or Cogitations by which we perceive External Bodies. For the Senses are nothing else but Perceptions of the Mind, that are the consequences of several Motions made in the Brain; our nature being such, that by occasion of these motions, produced in our Organs, several Ideas and Figures of the things are represented to us.

II.
What an
Organ is,
and how
manifest
they are.

An Organ is that part of the *Body*, which receives the impulse or action of the Object; or is that Natural Instrument by means whereof an Animal perceives something. Some Organs are External, which have their Inlets in the outward part of the *Body*, as the Eyes, Nostrils, Ears and the Nerves that are joined to them: Others Internal, which lie hid in the inward parts of the *Body*, as the Brain, the Spirits, the Pineal Kernel.

III.
How the
Senses per-
form their
Functions
in the Body.

For seeing that our whole *Skin* and *Flesh*, whereof the outward *Habit* of our Bodies do consist, are interwoven with several *Twigs* and *Tendrils* of the Nerves, when these are distended by the Animal Spirits rushing into them, they are easily put into motion by the least jostling of outward Bodies: which motions according as they are grateful or hurtful to the Bodies in which they are excited, do exhibit variety of sensations to the Soul. As for Example, because Tangible Objects touch our Bodies, they produce a motion in the Organ, by the Help of the Nerves, the Extremities whereof are extended throughout the whole Body, which motion being immediately carried to the Brain, and thence communicated to the Soul, which is intimately present to it, doth variously affect the same according to the diversity of the Nerves, and structure of the Organ.

IV.
There be
three De-
grees of
Sensation.

This will appear more clearly, by considering these three degrees in every sensation: the First when the Organ is affected by foreign Bodies; or when the Impression is made by the object it self, which being received into the Organ of Sense, carries the Type or Character of the sensible thing along with it; and this is nothing else but the Agitation of the Particles of that Organ, with some variety of Position and Figure proceeding from that Agitation. And this first degree is common to Men with Brute Beasts. The Second is the Perception of the Soul, heeding or attending to that motion, which immediately follows upon the former degree, because of the intimate presence of the Soul to the Organ so moved. The Third comprehends all those Judgments, which we form by occasion of these motions. Which Progress, if it be well heeded, it will be manifest, that all Bodily Objects are therefore only perceived by us, forasmuch as they move the Nerves that assist such and such Organs.

V.
The Three
Degrees of
Sensation
illustrated
by an Ex-
ample.

As for Example, when I see a Stone, or any other Object, it is because the Light reflected from the Stone moves my Eye: for nothing else proceeds from the Objects to our Senses but motion only,

or an Impression. Which motion is readily conveyed from the Bottom of the Eye through the Optick Nerve, or its small Fibres to the Brain, and Seat of the Soul; upon which impression immediately follows our perception of Light or Colour; and then the Judgment whereby the Soul concludes the thing to be of such and such a Colour.

For from the variety of the Motions that are made in the Organs, and conveyed to that part of the Brain, from whence the Nerves proceed, divers Senses are produced. Thus by the force of the motions that are made in that part of our Brain, whence the Optick Nerves do proceed, we are affected with the Sense of Light, and by the variety of those motions, with that of colour. Thus by the motion of the Nerves that belong to our Ears, we perceive Sounds; and by those that are dispersed through our Tongues, divers Tastes, Relishes and Savours. And the same may be said of the perceptions of Titillation, Pain, Hunger, Cold, &c. all of them depending on the motion of the Nerves.

For seeing that the Ventricles of the Brain are perpetually filled and distended by the Animal Spirits, as we see that the Sails of Ships, are blown up and stretched by the wind: And since in the midst of the Brain we find that Kernel placed, which is called by Physicians, Conarion, or the Pine-Apple-like-kernel (of which more hereafter) being surrounded every way with the Animal Spirits, there is no agitation so small or inconsiderable that can happen to the small Fibres or Filaments of the Nerves, but that it must be communicated to the Brain, and consequently be impressed on the Animal Spirits contain'd in it; and by means of them to the foresaid Kernel, and consequently to the Soul whose Residence it is. For so we are taught by Learned Men, that we never feel or are sensible indeed, except we feel, that is, perceive, that we feel. And thus ARISTOTLE himself tells us Problem 23 Sect. 11. that Sense, when it is separate from Understanding, is only insensible labour, whence it is said that the Mind sees, the Mind hears.

We may conclude therefore that our Soul doth not stand in need of any sensible Species proceeding from the Objects, to make it capable of Sense, the motions impressed upon the Body from without being sufficient for this purpose, as may be proved by manifold Experience: For when a Man is hit on the Eye, he perceives flashes of Light, tho' indeed he be in the Dark, and cannot discern any Objects. Whence it is evident, that this Sense is only to be ascribed to that violent agitation impressed upon the Organ of Sight. And something not unlike to this happens to those, who having for some time fixed their Eyes upon the Sun, upon turning their backs upon it, or shutting their Eyes, think they see a vast variety and mixture of Colours. The cause whereof is the concussion of the Strings or Fibres of the Optick Nerve.

Whence we may be convinc'd of that palpable Error of the Peripateticks, who suppose the Sound, that is received into the Ear, to be in the Air, or in the Sounding Body: And in like manner, that Light and Colour are in the Flame, and in a Wall or other Object; because they do not feel a Sound, Light, and Colours in themselves, as they feel Pain and Tickling; supporting their Opinion also with this

VI.
The Diversi-
ty or Va-
riety of our
Senses, pro-
ceeds from
the Differ-
ence of our
Nerves.

VII.
All Moti-
ons are con-
veyed to
the Brain.

VIII.
Our Senses
are no more
than Moti-
ons.

IX.
The Error
of the Peri-
pateticks
about the
Cause of
Sense.

Argument, That the Colours that are seen, appear to us much bigger than our selves.

X.
This common Error
refuted.

But that these Arguments are of no force in this case will appear, if we consider, that we have a sense of many things which are without us, and which we judge to be much greater than we our selves are, tho' there be nothing without us that effects such Sensations in us. For Mad-men, and such as are in a high Fever, do sometimes see, or think they see many Appearances or Representations, which are not impress'd upon their Eyes from without. In like manner it frequently happens when we are asleep, that we think we hear Sounds, or see Colours, after the same manner as we do when we are awake; and then attribute that Sound, and those Colours, to External Objects, and imagine them to be much greater than they are; when indeed there is nothing without us, to which we can attribute them.

XI.
There is no
Necessity
for our
admitting
of Inten-
tional
Species.

Neither is there any thing that obligeth us to admit such Images as these, for the Explication of the Sense of Seeing, or any other; since we find that there are many things that can produce Affections and Commotions in our Souls, which have no likeness at all with the Objects they signify: As when Words spoken, or committed to Paper, represent the Slaughter of Men, Destruction of Cities, or Storms at Sea; or excite the Affections of Love or Hatred: Which Representations or Thoughts bear no resemblance at all with the things they signify.

XII.
Because
they are
not Intelligible.

Besides these Species (which are commonly called Intentional) are so obscure, that the Nature of them cannot be understood: For they are not Corporeal or Divisible, seeing they are found whole and entire in every least part of the Subject or Medium. And if they be Indivisible, as most suppose them, and of an ambiguous Nature between Body and Spirit; how come they to move our Senses, yea, and sometimes hurt them too? Or how can they represent Extended Beings, being without Extension themselves?

XIII.
Neither is
the Cause
of them
intelligible.

Neither is the Original or Cause of these Images less obscure, than they themselves are: For how can we suppose that sluggish Bodies can by Emanation send forth such excellent Forms? Nothing being more wonderful or inexplicable, than how such Spiritual Forms should continually be procreated by Terrestrial Bodies, or flow from them. Besides, by what Chariots or Vehicles are they conveyed to us? Do they come solitary to us from the Object? Or are they diffused and multiplied by Propagation, and that in a Moment of Time?

XIV.
The Senses
are in the
Soul.

Wherefore tho' every one (as DES CARTES saith, in the beginning of his Treatise of Light) be apt to persuade himself, that the Ideas which we have in our Thoughts, are like the Objects from whence they proceed; yet can I find no Reason, to assure my self thereof: But on the contrary do meet with many Experiments, that may make us to question it. For if Words that signify nothing of themselves, but only from Custom and Human Institution, are sufficient to make us conceive many things, wherewith they bear no resemblance at all: Why may not Nature as well appoint a Sign, which may make us, to have the Sense of Light; tho' indeed, it contain nothing that is like that Sense? Don't we find, that in this manner she

hath appointed Laughter and Tears, whereby we may read Joy or Sorrow in the Faces of Men? But you'll say, That our Ears make us sensible of nothing but the Sound of Words, and that it is our Soul only which remembers what these Words signify, that does represent the same signification unto us at the same time. To which I Reply, That it is our Soul also that represents to us the Idea of Light, as often as the Action which signifies the same, doth touch our Eye.

Neither is it less difficult to explain, how these Images can flow from the Objects. For what virtue is there in them, to produce these Species? Or how shall they be received into the Organs of the Outward Senses, and from thence be conveyed through the Nerves to the Brain? If the Species be received by the Sense, how is it that it is not known or perceived by it, since every thing that represents ought to the Knowing Faculty, is objectively related to it, inasmuch as it supplies the room of the thing it represents?

None of these things were ever yet fully explained by those, who so much cry up Sensible Species; nor ever will be, as I suppose. Besides, how will they go about to explicate the Sense of Pain and Tickling by the help of these Images? The Point of a Sword, for Example, is thrust into a Body, which causeth a dissolution of Parts, whereupon Pain follows: Where shall we be able to find either in the Sword, or the Division of the Body, any Species that is in the least like the Sensation of Pain, that follows thereupon? What Analogy hath the application of our Hand with the Sense of Titillation? Conclude we therefore boldly, that Pain, and all other Sensations, are therefore excited in us; because the Parts of our Body, by the Touch or contact of another Body, are locally moved; which motion of the Nerves, if it be moderate produceth Titillation; but if violent, Pain.

Moreover, what is Light, but the motion of the Subtil and Aethereal matter, which shakes and agitates the little Nerves of the Retina or Network membran or coat of the Eyes? What is Sound, but the motion of the Air, which strikes the Drum or Organ of Hearing? Inasmuch therefore as divers Objects variously strike the Organs, it can be no otherwise, but that the Soul, which is placed in the middle of the Brain, must by means thereof perceive the differences of Sensible things: Somewhat in like manner as a Blind-man, by the motion of his Stick, can discern or distinguish a Stone from Sand, and Earth from Water. Because there is nothing, besides Motion, which can strike the Organs of the Senses, or affect the Mind it self.

Sense (by which word nothing else is understood, but a Faculty of perceiving Sensible Objects) is fivefold, viz. Feeling, Tasting, Smelling, Hearing and Seeing, according to the diversity of Objects that move the Nerves of the several Organs; and the variety of the Organs themselves, and the modes or manner of their being affected therewith. Which cannot but happen, if the Organ that is affected be sound and whole, with a sufficient distance of the Object from the Organ, and a fit Medium. By defect of the first of these, the Sense often mistakes in those that have the Yellow Jaundies, or Agues: For want of the second, the

XV.
It cannot
be conceiv-
ed how
these Images
should
reach the
Brain.

XVI.
The Sense
of Titillation
or Pain, cannot
be explained
by Species.

XVII.
Light and
Sound are
Motions
only.

XVIII.
Of the
Five
Senses.

Object cannot be discerned, if it touch the Organ: And by failure of the third, the Sight that perceives Objects through a misty Air, or partly through the Water, and partly through the Air, is very apt to mistake the true Modifications of them.

XIX.
The Division of the Senses into Internal and External.

The Senses are also commonly divided into Internal and External. The Internal are 2, viz. the Common Sense or Phantasie, and Memory. The External are the 5 already spoken of, and are called External, because they are produced in us by the help of outward Organs: Tho' indeed, if we will speak accurately, all these 5 Senses, called External, are Internal, forasmuch as it is the Soul alone, which residing in the Brain, Sees, Hears, Tastes, &c. It may also be said, that there is but one only External Sense, viz. that of Feeling; because no Sense can be without Contact and Local motion. Thus, if we would taste any thing, it is necessary that the Food should touch the Nerves subservient to that Sense, that so the said motion may be conveyed to the Brain, or the Common Organ of Sense; and the same may be said of all other Senses.

CHAP. XI.

That the Senses are an Effect of the Nerves; and that the Soul of Man only feels, forasmuch as it resides in the Brain.

I.
How the Nerves conduce to the forming of the Senses; and how the Soul rules in the Brain.

THO' it sufficiently appears from the foregoing Chapter what Sense is, and how by the Ministry of the Nerves External Objects are communicated to us; yet it remains still for us to enquire, how the Nerves perform this; and why the Senses rather have their residence in the Brain, than in any other part of the Body. Both which, tho' they be different Points, I shall comprehend in this Chapter.

II.
Three things are to be considered in the Nerves

In the first place, we are to take notice, that the Nerves are Vessels fitted for the containing and conveying of Spirits, proceeding from the Pith within the Brain. Secondly, That there are 3 things to be considered of in the Nerves; First, The thin Skins wherein they are wrapt or covered, which proceeding from the Coats or Membranes that encompass the Brain, are dispersed throughout the Body into small branches like Pipes. Secondly, That their Inward Substance, which is divided into very fine filaments or Strings, do reach from the Brain, whence they take their rise, to the utmost Parts of the Body, with which these Nervous filaments are interwoven. Lastly, The Animal Spirits, which like a Wind, or most subtil Air, rushing through these little Pipes, do move the Muscles, by way of Inflation or blowing of them up. It remains now that we say something, how those Strings or Capillaments which are within the Tubes of the Nerves, are subservient to Sensation.

III.
How the Nerves are subservient to Sensation.

Which will not be difficult to understand, if we suppose that these Capillaments do reach to the Extremities of all the Members, that are capable of any sense; so that if any part of those Members, to which the Nerve is fastned, be never so little stir'd, at the same Moment that part of the Brain from whence that Nerve proceeds, must be

moved also. Which we may Experience in a stretched-out Rope, whereof if the one end be touched, the other must be moved at the same time. So that all the diversity of Impressions that are made upon the Brain, do arise from the Nerves, which carry the various Qualities of the Objects along with them.

We must therefore imagine, that those small Filaments that are derived from the inmost Recesses of the Brain, and constitute the Pith or Marrow of the Nerves, are so disposed in all those Parts that are the Organ of any Sense, as that they may be most easily and readily moved by the Objects of those Senses. And that whensoever those Filaments are never so little moved, they draw those parts of the Brain, whence they proceed, and at the same time open the Orifices of some Pores, that are in the inward Surface of the Brain, through which the Animal Spirits in the Ventricles of the Brain, begin immediately to direct their course, and through them rush into the Nerves and Muscles that are the Instruments of those Motions, that are altogether like them that are excited in us, when our Senses are so and so affected.

As to the second Particular, viz. That the Soul of Man doth feel, that is, sensibly perceive all things; not as it is in the Organs of the External Senses, but only inasmuch as it is in the Brain, which is the Center and Rise of all the Nerves, this is evident from Examples and Reason. For when we see Light, or hear a Sound, we must not imagine that the Soul exerts this Act of Sensation in the Eye or the Ear; but that it perceives these things in its own place or seat, by means of the Nerves that reach from those parts to the Brain. For if the Soul did see in the Eye, and hear in the Ear, since both these Organs are double, there must needs follow a double perception of one and the same Object, at the same time: And since the contrary is most evident, it follows, that the Soul feels only in that part of the Body where the 2 Impressions, which proceed from one Object, through the double Organs of the Senses, are united again into one, before they affect the Soul.

This may be confirmed from manifold Experiments: For we find by daily Experience, that the Vapours which ascend from our Stomach to the Brain, and being condens'd there, do obstruct the passages through which the Animal Spirits have their course, do deprive a Man of the Power of Sensation. We find also that Diseases, which affect the Brain, or Wounds that are inflicted in it, do destroy the Senses; as is manifest in those that are struck with the Apoplexy. In like manner in Frenzies, wherein the Imagination is spoiled, Remedies are applied to the Head, which would be very foolishly done, if the Senses had their Residence in any other part of the Body. Hence it is that they who are seiz'd with the Apoplexy, are immediately deprived of all their Senses, so as not to be sensible, tho' they be slash'd with Knives or prick'd with Pins. And for the same Reason it is, that Persons that have their Attention fix'd upon any thing, do not take notice of things that are done in their presence; because the Soul residing in the Brain, is otherwise taken up, so as not to take notice of the things that are offer'd unto it.

IV.
How the Body is excited from External Objects, to move it self.

V.
The Soul of Man hath its Residence in the Brain.

VI.
Proved from the Experiment of Vapours and Wounds.

D d d d

But

VII.
Another
Instance
taken from
those, who
are troubled
with the
Vertigo, or
Turning of
the Brain.

But no more convincing *Argument* can be al-
ledg'd to prove, that the *Soul* doth sensibly per-
ceive in the midst of the *Brain*, than that which
is taken from the *Vertigo*, in which all *External*
Objects seem to move round; whereas indeed there
is no such *motion*, neither in the *Objects* them-
selves, nor in the *Outward Senses*; but it proceeds
only from the *Spirits* in the *Brain*, being so
moved, which affecting the *Soul*, it rashly attri-
butes the said *Circular motion* to the *Objects* that
are about it.

VIII.
The same
thing con-
firmed
from the
Pain that
persons
think they
Feel in the
part they
have lost.

Moreover, they that are earnestly busie about
Serious Matters, or are wearied with long *Study*,
are sensible of a *Pain* in their *Head*; which I my
self, after a little *Study*, frequently Experience:
Which would not be so, if the *Soul* had not its
Residence in the *Brain*, and did imagine and feel
there. Besides, it sometimes happens that *Pain*
seems to be felt in that part which is cut off from
the *Body*; according to what *DES CARTES*
tells us of a *Girl* that had her *Arm* cut off, who
afterwards complain'd of a *pain* she felt in her
Fingers. Which could not proceed from any
other Cause, but because the *Nerves*, which came
from the *Brain* to the *Hand*, upon the cutting off
of her *Arm*, reacht no further than her *Elbow*,
where being affected after the same manner, as
they used to be when her *Hand* was yet *pained*,
made her suppose, that she felt the same *pain* she
formerly felt in her *Fingers*. For such is the Na-
ture of our *Body*, that no part of it can be moved
by another, which is a little distant from it; but
that it must be moved in like manner by those
Parts that come between. As is manifest in a
Rope, the End whereof may as well be pull'd
or hal'd by that Part which is nearest to the midst,
as by the other End opposite to it.

IX.
When we
have lean-
ed long
upon our
Elbow, we
find a
Pain in
our Little
Finger.

In like manner it sometimes happens, that after
having leaned long upon our *Elbow*, we are sen-
sible of a *Numness* in our *Little Finger*; because
the *Nerve* which ends in that *Finger*, being too
much prest upon, doth affect the *Organ* of the
Common Sense, as if the *Finger* it self were so
prest. For we are wont to affix the *Sense* of *Pain*
to that part, which is wont to be moved by the
Objects, and wherein the stretched *Fibres* of the
Nerves are terminated.

X.
In what
part of the
Brain the
Soul hath
its Seat.

Wherefore it is necessary, that the *Soul* have its
Residence in that part of the *Brain*, to which the
Filaments of our *Nerves* do reach; to the end
that it may take care for the Security of all the
parts of the *Body*, and may have timely notice of,
and provide for any *Casualties* that happen to the
Body. For tho' all the *Changes* of the *Fibres*,
consist only in some certain *motions*, which com-
monly do only gradually differ; yet must the *Soul*
consider them as *Changes* that are *Essentially* dis-
tinct, and that forasmuch as they cause so great
an *Alteration* in the *Body* to which it is joyned.
For the *Motion*, by Example, that causeth *Pain*,
tho' it frequently differ but little from that *Motion*,
the effect whereof is *Titillation*: Yet, because by
the former some of the *Fibres* of the *Body* may be
pluck'd out of their places, or broken, whereas
the latter is an *Argument* of the firm and entire
Constitution of our *Body*, so it is that the *Soul* ap-
prehends these 2 *motions*, as being essentially distin-
guish'd. As to what particular part of the *Brain*
the *Soul* hath chosen for its *Residence*, shall

be declared in the next Part of these *Institu-
tions*.

But you'l say, It cannot be denied, but that we
see with our *Eyes*, and feel pain in our *Feet*: Why
then should we say, that the *Function* of *Sense* is
only performed in the *Brain*, and not rather in
these outward *Organs* of our *Bodies*?

True it is, that the *Impression* that is made by
the *Object*, is begun in the *Organs* of the outward
Senses; but it is not perfected or compleated there.
We see with our *Eyes*, forasmuch as the *Impressions*
of *Light* and *Colour* are made upon them: But
all this while the *Action* of the *Soul*, whereby this
Impression is perceived, is exerted in the more par-
ticular and chief *Residence* of the *Soul*; as will
appear more plainly in what follows.

CHAP. XII.

Of the Senses in particular; and first of
the Touch.

Tho' the *Touch* be but a Dull *Sense*, and with
respect to its *Action* be Inferiour to the other
Senses, yet we must first of all handle it; not
only because it is the most necessary *Sense*, but also
the most common, as being to be found in every
Animal, how imperfect soever, and diffused
throughout all the Parts of our *Body*. That it is
more Common than the rest of the *Senses*, appears
in this, that the other *Senses* are nothing else, but
several Species of *Touching*; which tho' they be
perfect and exquisit, yet cannot their *Functions* be
understood, but with some proportion to the
Function of the *Touch*. For no *Organ* of our
Body can be moved, without another *Body* touching
it. Besides, the *Touch*, like the other *Senses*, is not
tyed to one particular part of the *Body*, but is
found in all the *Nervous*, *Fibrous*, and *Membran-
ous* parts of it. For it is communicated to the
whole *Body*, as a Cap-a-pee Armour, to receive
the Attacks and Impressions of all *Sensible Qualities*.
It is also very necessary for the defence of *Life*,
and the avoiding of *Dangers*, which our *Bodies* are
obnoxious to from *External Objects*. For the
Touch is as it were our *Monitor*, advising us what
we are to avoid; and what we are to do in these,
or the other Circumstances.

The *Touch* therefore, as it is distinguish'd from
the rest of the *Senses*, may be defined, An outward
Sense that is most common and necessary, by means
whereof an *Animal* doth receive *Tangible Quali-
ties*.

And thus the *Touch*, as it is taken in a larger
Sense, may be distinguish'd into *Internal* and *Ex-
ternal*: That being the *Inward Sense* of *Touching*,
which is performed in the *Inward Organ*; for
seeing that the *Nerves* and *Fibres*, which are the
the *Organs* of these *Senses*, are dispersed within,
as well as on the outside of the *Body*, accordingly
there is an inward as well as an outward *Sense* of
feeling. And therefore the *Veins*, *Arteries*, *Mem-
brans*, and their appendages the *Coats* are partakers
of this *Sense*. Thus the *Pain* which we feel in our
Guts, and in other *fibrous* parts, belongs to this
Inward Touch. For this *Sense* is excited upon
every least *motion* that is made in any *fibrous* part,
supporting it to be strong enough to be conveyed to
the *Brain*.

The

XI.
The Impres-
sion from
the Object
is only
made upon
the Soul.

I.
The Touch
is first to
be treated
of, as being
the most
common
and neces-
sary of all
the other
Senses.

II.
What the
Touch is.

III.
The Touch
divided
into an
Inward
and Out-
ward.



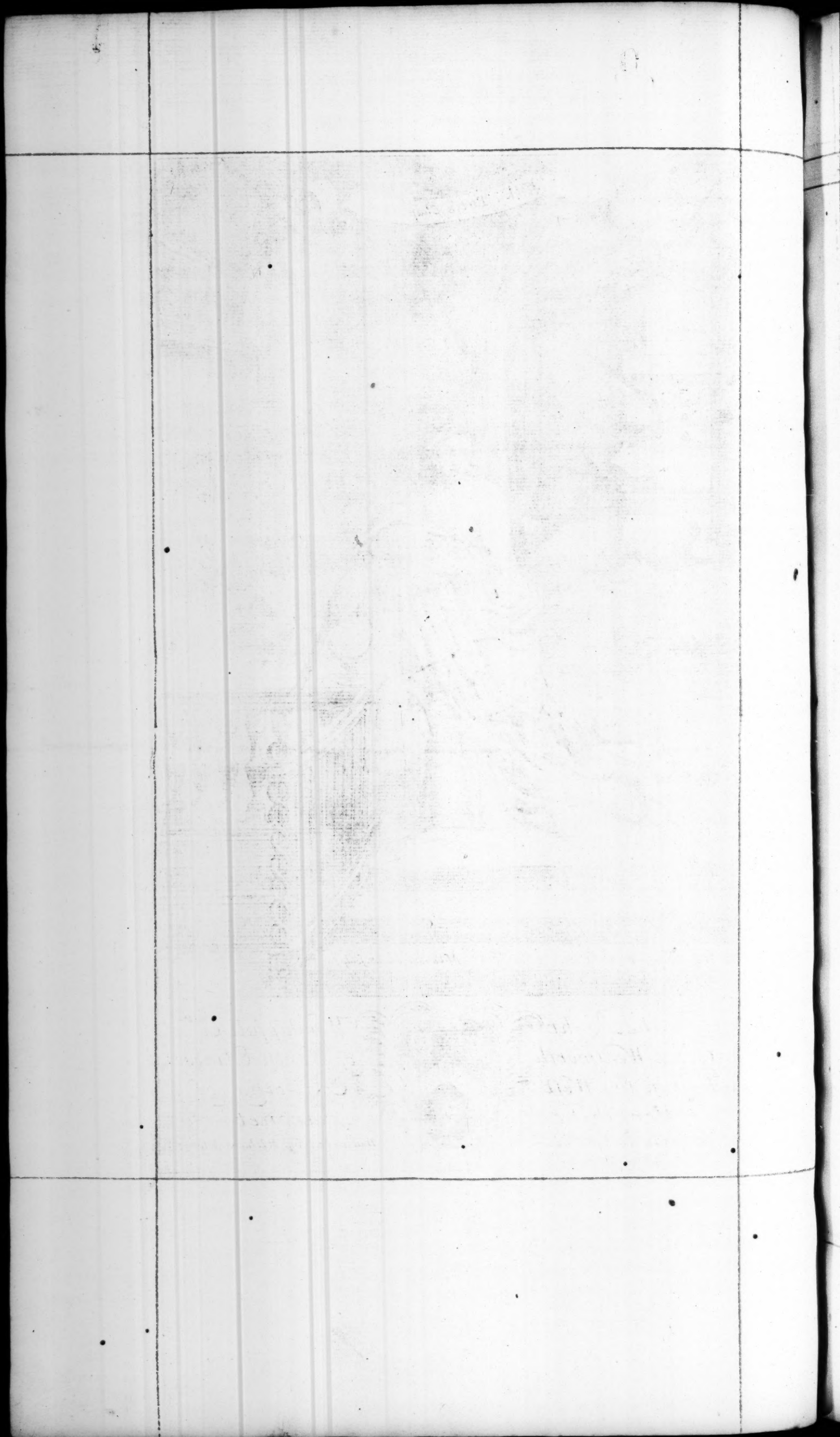
To the Right
John Wentworth
hall in the West
Yorkshire

This Plate is humbly



Worshipfull S.^r
of North Elmes:
Rideing of
Baronet

Dedicated by Richard Blome



IV.
The Organ
of the
Touch, or
Sense of
Feeling as-
signed.

The Organ of *Feeling* is neither the *Flesh*, nor the *Membrans*, nor the *Skin*; but the *Nerves* and their *Filaments*, dispersed throughout the whole *Body*. For this *Sense* is excited, as oft as the *Nerves* and their *Filaments*, being shaken with more force than ordinary, do communicate their agitation to those parts of the *Brain* they more particularly relate to; as we see it happens in a stretched *Cord*, which being shaken at one end, immediately imparts its *motion* to the other.

V.
The Opini-
on of our
Modern
Anatomists
concerning
the Organ
of Feeling.

Our *Modern Anatomists* fix the Organ of *Feeling* either in the *Skin*, the whole *Substance* whereof is *Nervous*, or in some *Bodies* that lye between the *Skin* and the *Cuticle*, which with *MALPIGHIUS* they call the *Sinewy*, or *Nervous Nipples of the Skin*, which they take to be the primary and immediate Organ of the *Touch*; because these little *Nipples* or *Prominences* are found to be more in number, and larger in those parts of the *Body* that are endued with the most exquisite *Touch*, as the *Palm* of the *Hands*, and the *Ends* of the *Fingers*, than in the other parts. *MALPIGHIUS* first discover'd these in the *Feet* of a *Lamb*, *Hog*, and other *Animals*; for as soon as their *Hoofs* are pull'd off, certain little *Bodies* do appear extended in length, and reaching to the *Surface*: So that *Hoofs* and *Nails* seem to be nothing else, than the appendages of the *Cuticle*, and of the *Nervous Nipples*, which being pull'd out do leave certain hollow *Pipes* behind them.

VI.
In what
parts of the
Body these
Nervous
Nipples
may be dis-
cerned.

These *Nipples* are not only discover'd by the help of a *Microscope*, but also by the bare *Eye*, in the extream parts of the *Nostrils* of some *Animals*; as of an *Ox*, *Swine*, &c. And that the Organ of *Feeling* is chiefly to be plac'd in these *Nipples*, *MALPIGHIUS* with reason conjectures, because they are nothing else but a propagation of the *Nerves* and *Tendons*, proceeding from the *Fibres* of the *Muscles*. And forasmuch as the *Touch* is performed, as well as all the other *Senses*, by the *Nerves* and *Fibres* of the *Tendons*, it seems that no more proper Organ of the *Touch* can be assigned: Forasmuch as according to *STENO*'s Observation, the *Skin* is for the most part nothing else, but a *Texture* of *Nerves*, *Arteries*, and *Veins*.

VII.
What are
the Objects
of the Touch

The *Causes* or *Objects* of the foresaid Affections, which the *Schoolmen* call *Sensible Qualities*, are *Heat* and *Cold*, *Moisture* and *Driness*, *Hardness* and *Softness*, *Heaviness* and *Lightness*, *Smoothness* and *Roughness*, *Titillation* and *Pleasure*; and other *Modifications* of the *Body*, which produce some change of *Motion*, *Texture* and *Figure* in them. For all *Objects* indifferently cannot affect the *Touch*, but it is requisite that the Affection be considerable, and such as to make it self sensible. For seeing that the *Nerves*, which are the *Organs* of this *Sense*, are of some Bigness, they cannot be moved by very little *Bodies*; because, according to an *Axiom* in *Natural Philosophy*, a *Body greater in Extension being at Rest, hath by so much the greater force to resist a less*. Which is the Reason that we do not feel the continual *Steam* and *Emanation* of little *Bodies*; for tho' they pass through our *Skin*, yet because their Littleness is such that they cannot sufficiently shake the *Nerves*, neither are they able to make any impression upon the Organ of *Feeling*. And the same also is to be said with respect to the other *Senses*.

But to the end we may more clearly understand how this *Sense* comes to be exerted, we must call to mind, what hath been said in the foregoing Chapter, viz. that some *Strings* or *Filaments* proceeding from the *Brain*, are dispersed throughout all the parts of our *Body*, and that these constitute the *Nerves*, which being filled with the *Animal Spirits*, are stretched out like so many *Cords*, which are diffused throughout the whole *Body*. Which *Nerves* whenever they are somewhat forcibly shaken, immediately draw the parts of the *Brain*; as when a *Rope* is pull'd, the *Bell* which is at the end of it *sounds* immediately; and by this means the *Soul*, which resides in the *Brain* receives a *sense* of the thing which hath moved the *Nerves*. Thus when we put our *Hand* to the *Fire*, the particles thereof being swiftly moved, are of sufficient force to agitate the *Skin* that covers the *Hand*, and consequently the *Nerves* that reach from the *Hand* to the *Brain*, and thereby to make the *Soul* to perceive the *sense* of *Pain*. For such is the near Relation between the *Brain* and all the *Nerves* diffus'd through the *Body*, that the *Soul* by their means receives the Impression of *External Bodies*. Thus we can distinguish several *Bodies*, by means of a *Stick* held in our *Hands*, and reaching to the *Bodies* we would distinguish, as *Stones*, *Clay*, *Metals* and the like. Yea there are some persons born blind, who only by their *Touch* can distinguish the several sorts of polish'd *Marble*, and the various impressions of *Coin*. And for the same reason it is why any motion on the *Lips* is so very sensible, viz. the great tenderness of the *Skin* that covers them, which makes the *Fibres* of those *Nerves* that constitute it to be easily shaken and moved, as before hath been said of a stretched *Cord*.

It may be you will object that the *Nerves* are not so stretched, as a *Rope* or *Cord* is. I grant it, yet doth not this hinder the instance of a *Cord* to be very proper here, since it is not needful that in a similitude all things should be the same. Now a *Cord* and a *Nerve* agree exactly in this, that as when one end of a *Cord* is touch'd, the other is shaken; so when any *Nerve* in the *Body* is moved, the motion is immediately convey'd to the *Brain*. For tho' the *Nerves* be not so much stretched as a *Cord*, yet their apt disposition for the communication of motion, fully makes amends for that want of *Tension* in them.

But if it be so that the *Sense* of *Feeling* is performed by the *Nerves* derived from the *Brain*, it may be queried whence so many *Species* of *Feeling* do arise: For tho' there be many *Nerves* in the *Body* of *Man*, and manifold *Tangible Qualities*, yet there are no different *Nerves* made use of, for the producing of these different Affections: for the very same *Nerves* that produce *Pain*, cause the sense of *Pleasure* also, and so of the rest; but the same *Nerves* receive the impulse of the several *Objects*, being sometimes moved by these, and at other times by others.

I Answer, That this Diversity proceeds from the difference of the *Objects* that affect and move the *Nerves*, much like the strings of a *Lute* which give a different sound, according to the different touches of him that plays upon it. Thus when the insensible parts of any *Body*, variously agitated, are more swiftly moved than the *Particles* of our

VIII.
How the
Sense of
Feeling is
performed.

IX.
An Objection
Answered.

X.
Whence the
Difference
of the Touch
proceeds,
seeing
that the
Nerves are
the same.

XI.
This difference
proceeds from
the Diversity
of the
Objects.

our *Body*, our *Soul* perceives *Heat*, but if more slowly, then we are made sensible of *Cold*. Hence it is that what to an *Ethiopian* seems *cold*, to a *Scythian* appears *hot*. The same thing is likewise experienced by those that enter in *Bathes* distinguished by several degrees of *Heat*: for having continued some time in a luke-warm *Bath*, to prepare themselves to endure a very hot *Bath*, when they go back out of the *hot Bath* to the luke-warm *Bath*, that which before seemed *hot* to them at their first entrance, feels now *cold* to them.

XII.
What is
the Cause
of Pain and
Pleasure.

When the small *filaments* of the *Nerves* are pushed against, or drawn with so great violence, that they are broken and rent from the Member to which they were fastened, the *Soul* is made sensible of *Pain*; but when the said *filaments* are not broken, but moved without receiving any hurt, the *Soul* perceives a kind of *Bodily Pleasure*, which is called *Titillation*; which tho' with respect to its cause, it seems to differ but little from *Pain*, yet doth it produce a quite contrary effect. So when the *particles* that terminate a *Body*, do with an even *surface* press the *Skin*, the *Soul* apprehends it to be *smooth* and *polish'd*; but if the *surface* of the *thing* be uneven, then it perceives it to be *rough* and *rugged*. In like manner when *Bodies* are strongly born downwards, they represent to the *Soul* the *sense* of *Heaviness*; but when they do but gently tend downwards, they afford the *Soul* the perception of *Lightness*. When the *Particles* of a *Body* are so disposed as to resist the motion of our *Hand* or other *Members* of our *Body*, the *Soul* perceives the quality of *Hardness*; whereas when the *Particles* of any *Body* are so moved, as not to stop or resist the *Bodies* that meet them; the *sense* of *Fluidity* is imparted to it. And the same is to be said of all the other *qualities* that belong to the *touch* or *sense* of *Feeling*, which the *Soul* perceives differently according to the variety of the *modes* whereby the *Nervous Fibres* are affected.

XIII.
How it
comes to
pass that
since the
Touch hath
so many
Objects,
it is not
manifest.

XIV.
Answer to
the Question.

Another Difficulty may be started here, viz. how the *sense* of *Feeling* can be said to be one only *sense*, seeing it hath so many *Tangible Qualities* for its *Object*. For if the *Senses* be distinguished from each other by their *Objects*, why may not the *Sense* of *Feeling* be said to be manifold, because it hath so many different *qualities* for its *Objects*?

Notwithstanding all this, we must conclude the *Touch* or *Sense* of *Feeling* to be but one: for tho' the *Tangible Qualities* do differ, according to the various *Modifications* of *Bodies*, yet they agree all in this general Notion, that by means of the *Nerves* they move the *sense* of *Feeling*. As the *sense* of *Seeing* is not said to be double or twofold, because it hath for its *objects* *Light* and *Colours*, which are express'd by 2 different *names*; nor the *sense* of *Tasting*, tho' the *Tongue*, which is the *Organ* of it be affected with various *Tastes* or *Relishes*. Besides, the *Senses* are not only distinguished by their *Objects*, but also by the *Organs* and *Modes* whereby they are affected. And forasmuch as all *Tangible Qualities* agree in this, that they impress the same Affection upon the *Organ*, and that the whole difference of them depends on the Diversity of this Impression, it is evident that the *Touch* must be lookt upon as being only one *Sense*, and not many.

The *sense* of *Feeling* is sometimes deceived, as when *Women* that are subject to the *Fits* of the *Mother*, complain of an extream *cold* in their *Heads*. And thus also places under ground, appear to us very *cold* in the *Summer* time, and in the *Winter* warm; when as indeed upon making a tryal with a *Weather-glass*, we shall find that there is no such change in the *Temperature* of the *Place*.

XV.
Sense De-
ceptions of
the Touch
influenced.

CHAP. XIII.

Of the Sense of Tasting.

THE *Tast* is an *External Sense*, whereby an *Animal*, with the help of his *Tongue* and *Palat*, which are furnish'd with the *Nerves* subservient to this *Sense*, perceives the several differences of *Tastes* and *Savours*. Or according to others, the *Tast* is a sensation, by means whereof, after that the *Savoury Object* hath made a due impression of it self upon the prominent and porous little *Nipples* of the *Tongue*, the *Soul* residing in the *Brain*, perceives and judges of the difference of the *Savour* or *Relish*. For according to the sentiment of our Modern *Anatomists* the *Organs* of *Tast* are the foresaid prominent and porous *Nipples* of the *Tongue*, or small *Strings* which proceed from its inmost *membran*.

The *Tast*, hath some affinity with the *Touch*; and if we will believe *ARISTOTLE*, it is but a species of it. For whereas in the other *Senses*, the *Organs* are affected by their *Objects* at a distance, and are agitated by little *Bodies* flowing from them, the *Organ* of the *Tast*, requires an intimate contact with its *Object*, and cannot be moved by it at a distance. Yet there is this difference betwixt these *Senses*, that the *Organ* of the *Tast* is more intimately penetrated by the *savoury Object*, which more deeply insinuates its self into the *Fibres* thereof, than *Tangible Objects* enter the *Skin*. Hence it is that we see that persons who are over-tired, or that are fallen into a *swoon*, do presently revive, upon the drinking of a Draught of *Wine*; and *Men* that are like to die, are strangely recovered by taking some of the *Cordial* that is called the *Imperial Water*: which strange effects are only to be attributed to this, because the *Particles* of *Wine* and the *Imperial Water* dive deep into the *Pores* of the *Tongue*, and mingling with the *Spirits* do greatly revive them.

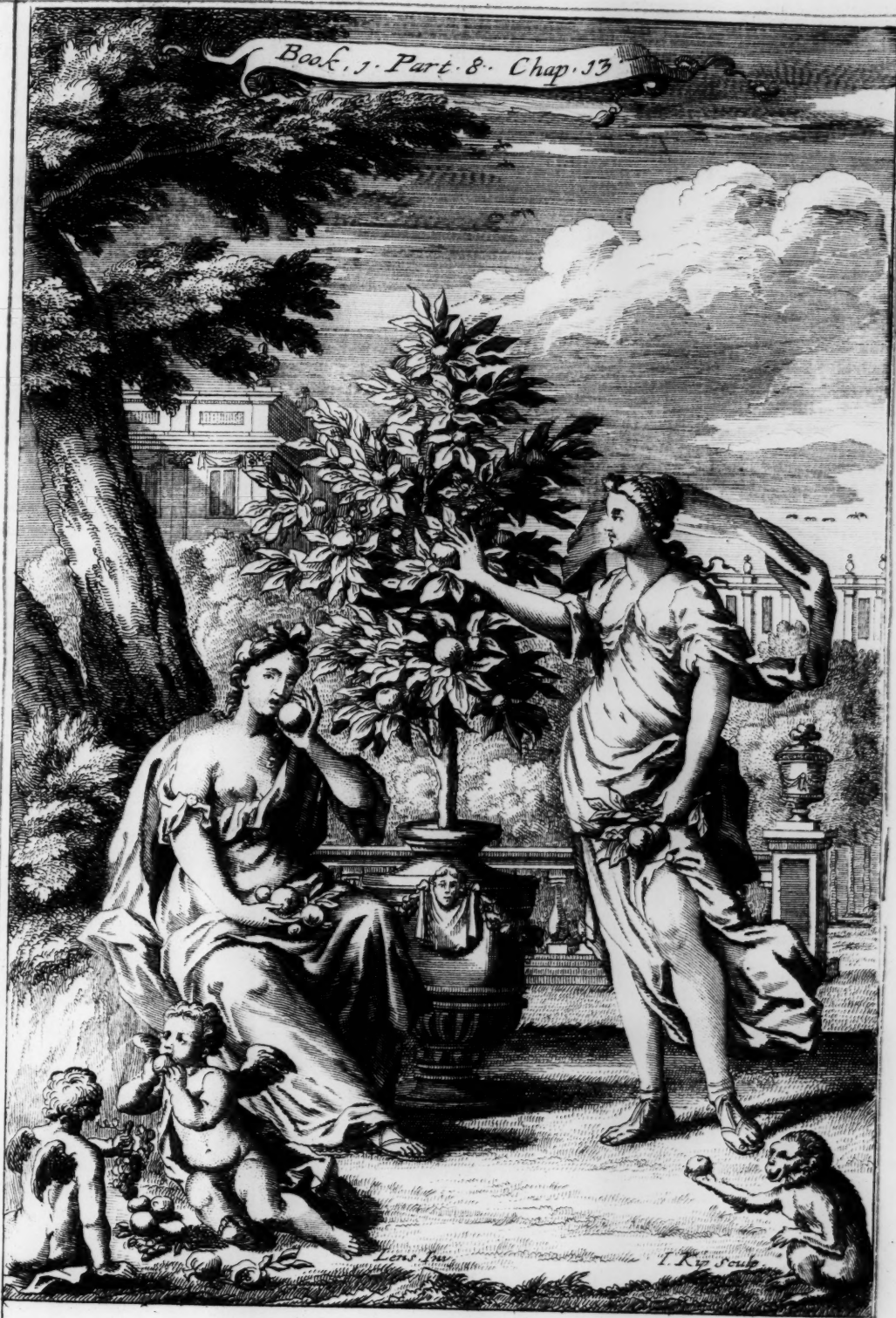
Moreover these *Senses* differ also, First by reason of their several *Organs*: For the *Organ* of *Taste*, is not like that of the *Touch*, diffused throughout all the *Fibrous parts* of the *Body*, but throughout one part only, viz. the *Tongue*; which alone is affected by *Savoury Objects*. Secondly, According to the *Disposition* that may be found in the said *Organ*: Thus a *Tongue* that is dry and without *Moisture*, toucheth dry things, but perceives no manner of *Tast* in them. Thirdly, Thick and whole *Bodies* affect the *Organ* of *Feeling*; whereas that of the *Tast* cannot be impress'd upon but by thin and liquid *Bodies*, or such as are divided into small parts: and for this Reason *Pills* that are swallowed whole communicate no *Tast* to the *Tongue* or *Palate*, or very little, and that only because some of the *particles*, in gliding over the *Tongue*, are dissolved.

The

I.
What the
Tast is.

II.
Whereas
the Touch
and Taste
do agree
and differ.

III.
Two other
ways
whereby
the Sense
is affected.





IV.
The Tongue
is the Or-
gan of
Tasting.

The Organ of the *Tast* is the *Tongue*, as well as the *Inward* and *Spungy* part of the *Palate*, because the *surface* of them both is full of those innumerable *Nipples* before mentioned. As concerning the *Tongue* it is evident, that being of a soft, loose and *spungy substance*, it is most proper to receive *Savoury Bodies*, mixed with some *moisture*. And accordingly we experience that if we touch any *Savoury Matter* with the *tip* of our *Tongue* only, we perceive the *Tast* of it: for the *Nerves* of the fifth and seventh *Conjugation* terminate in the *Tongue*, which being inserted into 9 or 10 *Muscles*, become the *Instruments* of various *Motions*. For besides the *Functions*, of *Speaking* and *Singing*, this *Organ* of the *Tongue* is of great use towards the *moistning*, *mixing* and *swallowing* of the *Meat*. All these *Muscles* divide the *Tongue* longwise into 2 parts, by means of a certain *Tendinous String*, so as that this *Organ*, as well as those of the other *senses*, seems to be *Double*. Now that not only the *Tongue*, but also the *upper part* of the *Throat* or *Palate* is the *Instrument* of *Tasting*, is very manifest, for when any *savoury meat* passeth towards the *Gullet* in order to its being *swallowed*, we perceive the *Tast* thereof, tho' it never touched our *Tongue* in the *inward* part of our *Palate* (which some call the *swallow*) forasmuch as its *Flesh* is *Spungy*, and very proper to admit the *Particles* of *Savoury Bodies*.

V.
That the
Particles of
any Savou-
ry Body
may enter
the Tongue,
Moisture is
required to
dilute or
mingle
with the
said matter

Now to the end that these *Particles* may penetrate the *Pores* of the *Tongue*, and pass through the *Texture* of the *Fibres*, some *moisture* is required for to steep, resolve, melt and convey them. Hence *Nature* hath so provided, that the *Mouth* where the *Food* is chewed, hath a continual *moisture* attending it, by means whereof, as a *Menstruum*, the *Particles* of *Sapid Bodies* are melted, and conveyed into the *Organ*. For as we find that an *Herb* being bruised with a *Pestle*, or any other *Instrument* in a *Wooden Dish* or *Bowl*, doth with its *Liquor* penetrate the *Wood*, and insinuate it self into its *Pores*; as is evident from the *Smell* and *Savour* of the *Herb* that remains in the *Bowl*: in like manner our *Food* being minced in our *Mouths*, by the help of our *Teeth* into small pieces, and steeped in our *Spittle*, doth easily affect the little *Nerves* of our *Tongue*, and is conveyed to the inmost parts thereof. And therefore *Salt* before it can affect the *Tongue* and be tasted, must be melted with some *moisture*; neither can *Pepper* be tasted except it be first steeped in, or mingled with the *Spittle* that is in the *Mouth*: for dry *Bodies*, without the *Vehicle* of *moisture*, cannot be conveyed to the inmost *Recesses* of this *Organ*.

VI.
How the
Sense of
Tasting is
performed
in the
Tongue.

From what hath been said, it may easily be understood, how the *sense* of *Tasting* is performed, viz. when any *savoury matter*, being, as it were macerated with the *Spittle*, is conveyed into the *spungy substance* of the *Tongue*, and in its passage doth after divers manners affect the *Nerves* inserted into the *Tongue*, by vellicating, biting, striking, tickling, wringing and stirring the same. Which different Affections are carried from the *Organ* to the *Brain*, where they make a different impression on the *Mind*, according to the diversity of the motion of the *Fibres* of the *Organ*. So that now it remains only to be explained whence the great variety of *Tastes* and *Savours* doth proceed.

Which will easily be done, if we remember that the *Faculty* of perceiving *Tastes* in us, is not unlike to that whereby we are sensible of *Pain*; that is, to the actuating of this *Power* nothing else is required, but that the *savoury Bodies* do move the slender *filaments* of the *Nerves* of the *Tongue*, or the prominent *Nipples* before mentioned, in such a manner, as *Nature* hath ordained for the effecting of the *sense* of *Tasting*. In-like manner as to the production of the *sense* of *Pain* it is sufficient, that the *Nerves* subservient to the *Touch* be moved after such a particular manner: So that all the difference of *savoury Bodies* doth depend on the *Thickness*, *Figure* and *Motion* of their *Parts*. This may be evidenced by some instances; for let us suppose the fore said *Fibres* of the *Tongue* to be agitated 4 several ways, viz. by *Salt*, *Vinegar*, or any other four *Liquor*, *Common Water* and *Brandy*, so as that the *Soul* thence is stirred up to perceive 4 distinct *Tastes*. We shall easily conceive that *Salt* doth therefore prick, and as it were cut the *Organ*, because it consists of long, stiff and various corner'd *Particles*, which with their points prick the small *Fibres* of the *Tongue*, and enter the same without the least bending or plying. *Vinegar* applied to the *Organ*, doth as it were slash and cut it, and by compression somewhat contract it, because the *particles* thereof by entering obliquely into the *Nerves*, do slash the thin *particles* thereof, and dashing against the thicker parts they become bended, and so enter the *pores* slantingly. *Common Water* doth not enter the *pores* of the *Tongue* at all, and therefore doth neither prick nor pierce it, because its *particles* do only softly flow upon the *Tongue*, and lying sideways, because of their easie *pliability* and bending, are scarcely perceptible by the *Taste*, and therefore *Water* is lookt upon as *insipid*. *Brandy* doth bite and vellicate the *Tongue*, because the *particles* thereof penetrate most deeply, and are most swiftly moved. And the like account may be given of all other *savoury Bodies*, which according to the different disposition of their parts, can make different impressions upon the *Organ* of *Tasting*.

The difference of *Tastes* may also be caused by the *Organ*; for the various *Texture* and *Disposition* of the *Tongue*, may occasion a difference in the *Taste* of things. Thus *persons* that have a more fine and tender *Organ*, take delight in delicate *Savours* and *Tastes*; whereas those whose *Instrument* of *Tasting* is more gross, delight in more coarse *viant*s and less exquisite *Tastes*. Thus *Country People* generally delight in coarse and *Salt Meats*; whereas *Children* are pleased with *Sugar* and *sweet things*. The reason is, because the *Fibres* of the *Nerves* are more fine and subtil in *Children*, and therefore are easily moved with a *sweet Taste*: whereas those of *Rusticks* are more gross and stiff, upon which nothing but strong and sharp *things* can make any impression. Wherefore it is no wonder to see that the *Food* which pleaseth the *Palate* of one *Man*, doth disgust another; because of the different disposition of the *Organ* in them both.

Yea it frequently happens that the same person; who at one time is pleased with some kind of *Meats*, may at another have an aversion against them; and we commonly experience, that those things which are most grateful to our *Palates* when we are *Hungry* and *Thirsty*, become un-

E e e e

pleasant

VII.
Whence the
Diversity
of Savours
and Re-
lishes doth
arise.

VIII.
The Differ-
ence of
Tastes may
proceed also
from the
Variety of
the Organ.

pleasant to us when we are full and satiated, and this because of some change in the *Texture* of the *Organ*, the *Savoury particles* not affecting the *Tongue* and *Palat* in the same manner, when the *Pores* of it are more straitened, than when they are dilated and more open.

IX.
Why some
loath those
Viands
which be-
fore they
desired.

Hence it is that *Old men* do loath some sorts of *Meat*, which they most delighted in when they were *Youths*; and that some *Persons*, after having accustom'd themselves to some sort of *Food*, are greatly delighted therewith, tho' before they loathed and could not endure it: Even because either the *Organ* in process of time grows dryer; or else, for that by *Custom*, and the frequent use of some sorts of *Diet*, some *folds* are formed in the *Organ*, which easily admit the *particles* of the *Meat*, which before they could not receive. The said variety of *Taste* may also proceed from the *Tongue*, being ting'd with the *Savour* of some *Salt*, *Butter*, or *Sour matter*, which hath not been effac'd by the eating of some *Sweet thing*, or by the drinking of a large draught of *Liquor*; for the Eating of *Sweet-meats*, and especially *Drinking*, doth so resolve the hard and longish *particles* of *Salt*, the crooked *particles* of *Bitter things*, and the cutting *particles* of *Sour things*, as to carry them along with it; And therefore it is that *Drink tastes* more grateful after the eating of *Sour things*, and more delightfully affects the *Tongue*.

X.
Deceptions
of the Taste,
and the
Causes of
them.

Sometimes the *Taste* happens to be mistaken, not about the Affection imprest upon the *Organ*, but about the Cause from whence it proceeds. Thus they who are sick of the *Faundes*, are not mistaken in that they suppose themselves to perceive a bitter *taste*; for they do so, because the *Gall* is mingled with their *Spittle*; but they are deceived in attributing that bitter *Taste* to the *Food* they eat: In the same manner as they suppose the *Object* they behold to be *yellow*, when indeed it is the *Gall* that depraves their *Organ*, and makes all the *Objects* they behold to appear of that Colour. And in like manner, sometimes our *Meat* seems to *taste* bitter to us, whereas indeed the said *sense* of *Bitterness* proceeds either from some *Humour*, wherewith the *Tongue* or *Palat* is tinged; or from the *Vitiating* of the *Nerves*, that are assistant to the *Fibres* of the *Tongue*. Yea, it happens sometimes, that we seem to perceive a *Taste*, without receiving any *food*, which cannot proceed from any other Cause, but from the defluxion of some *Humour* that hath such a kind of *taste*, or from some fault in the *Blood*, that is conveyed to the *Organ* of *Tasting*; as may be demonstrated by many Examples.

CHAP. XIV.

Of the Sense of Smelling.

I.
Why Beasts
excel Men
in the
Sense of
Smelling.

IT is certain, that *Man* is Inferiour to many *Beasts*, as to the exquisiteness of the *Sense* of *Smelling*: For *Beasts*, when they light upon any unknown *food*, do presently, by the Quickness of their *Scent*, discover the *Qualities* thereof, *Nature* thereby preventing those *Mischiefs* which otherwise might be the effect of their *Voracity*, by their too greedily devouring things hurtful to them, if they were not assisted with such an *Exquisite Scent*, which discovers to them the Suitableness or Unsuitableness of the *Food* to their

several *Natures*. By this Quickness of their *Sense* of *Smelling* they hunt out their *Prey*, tho' at a considerable distance from them, and tho' never so cunningly hid; according to the Relations we have in *Story* of *Ravens*, *Vulturs*, and *Apes*. Thus *Dogs*, by the Vivacity of this *Sense* pursue their *Game*, and follow the Steps of their *Masters*, tho' far out of their sight. *Tigers*, by the help of their quick *Scent*, pursue those that have robb'd them of their *Whelps*; and *Cats* find their way home, from whence they have been carried many Miles in a close shut-up *Basket*.

Now this *Sense* is more dull in *Man*; not only, as some suppose, because he abuseth this Faculty, and fills himself with the *Vapours* of too great variety of *Meats*: But either, because his *Organ* is not of such an *Exact Texture*; or because his *Brain* is too moist, and so dulls and clogs the force of the *Odorous Steams*, by entangling the *particles* thereof, and hindring them from entering the *Pores* of the *Nostrils*. And for the same reason it is that we can smell nothing under *Water*, because the *Nostrils* being stop't with *Water*, cannot admit the *Air* that conveys the *Odorous Exhalations*. Hence it is that they that have their *Heads* stuffed with a *Cold*, in a great measure lose their *Sense* of *Smelling* for that time; because the *Pores* that should admit the *Odorous Exhalations* are filled with the *Rheum*.

The *Scent*, or *Smelling*, is an *External Sense*, whereby an *Animal*, with the help of his *Nostrils*, which are furnish'd with very subtil *Fibres*, receives all manner of *Smells*. In all *Smelling* there is first a Collection of *Odours*, the Instrument whereof is the double Cavity of the *Nostrils*: In the Next place, the Sensation of the collected *Odour*, is propagated by means of some most subtil *Fibres*: And, Lastly, this *Sense* is terminated and compleated by the agitation of the *Nerves* and *Spirits*, in the *Conarion* or *Pine Apple-like Kernel*.

The *Anatomists* differ in their Opinions about the *Organ* of this *Sense*: For some of them make the *Processus Mammillares*, so called, to discharge this *Function*, which others attribute to the *Nostrils*. The *Processus Mammillares*, are 2 little bunches or protuberances of the *Brain*, in which 2 *Conduits* or *Passages* of the same *Substance* are terminated. However, these do not seem to be the *Organ* of *Smelling*; because both these *Mammillary Processus* are a portion of the *Brain* it self, consisting of the *Pith* or *Marrow* of it: Now, no *Physicians* ever owned the *Brain* to be the *Organ* of the *External Senses*. Besides, according to what we have before declared, the *Nerves* and *Fibres* are the *Organs* of the *External Senses*; but these *Processus* are too soft to be accounted *Nerves*; neither did ever any, that I know of, account them so. Moreover, if we place the *Smelling Faculty* in both these *Processus*, why do not we always perceive some *smell* or other, seeing that the *Air* continually flows to the *Brain*, with which the *Odorous Steams* are always mingled; but this contradicts Experience. It remains therefore, that we place the *Organ* of this *Sense* in the *Nostrils*, that is, in some very subtil *Fibres*, derived from the bottom of the *Brain* to the *Nerves*, which are not distinct from the *Nerves* that assist the *Sense* of *Tasting*, save only in this, that they do

II.
Why the
Sense of
Smelling
is more dull
in Man,
than other
Animals.

III.
What the
Sense of
Smelling
is.

IV.
What is
the Organ
or Instru-
ment of
Smelling.



Lons Inv.

I. Kip Sculp.



do not pass through the *Skull*, wherewith the *Brain* is cover'd; and that the *Fibres* also are more subtil and fine, than those that are affected by *Savoury Objects*.

V.
The Organ
of Smelling
is in the
Nostrils.

Sense it self assures us, that the *Organ* of *Smelling* is in the *Nostrils*; for who doth not experience that in them he *Smells*, that is, perceives the Affection that is impress'd by *Odorous Objects*? To which we may add, that forasmuch as this is a most subtil Affection, as being impress'd by that most fine *Steam* wherein the *Odour* is diffused, it doth not seem possible to be performed in any *Bone*, *Gristle*, or *Thick Membran*, and consequently that it can no where so properly be performed, as in this fine *Texture* of the *Nervous Fibres*.

VI.
Why those
that are
flat Nos'd
do not smell
well.

Whence it is that those who have their *Nostrils* flattened or beaten down by any *bruise* or *fall*, have but a weak or dull *Sense* of *Smelling*; because the *Nerves* design'd for this Function are too much compress'd in the upper-part of the *Nostrils*, and cannot give a free passage to the *Odorous Exhalations*. And on the contrary, *Dogs*, *Hares*, and other *Animals*, that excel in this *Sense*, have many little *Pipes* in the thin *membran* of their *Nostrils*, through which these *Odorous Exhalations* are freely transmitted.

VII.
How the
Sense of
Smelling is
performed.

The *Sense* of *Smelling* therefore is effected, when the most thin *Particles* of *Bodies* flying in the *Air*, I mean such only as are Subtil and Brisk enough for this purpose, do strike, tickle and vellecate the most thin *fibres* of the *Organ*, and affect it after various manners. The *Hollowness* of the *Nostrils* is a great help and advantage to the perception of *Odours*, especially if the said *Cavity* be wide at the Entrance, because then the *Odoriferous Particles* are more readily conveyed to the *Brain*. For the *Cavity* of the *Nostrils*, is like a *Chimney* or *Funnel*, through which the *Odorous Particles* do ascend, and being gather'd together, do penetrate the winding of the *Nostrils*. Wherefore they that have long *Nostrils*, have a more quick *Scent* than others; because they attract more of the *Odorous Steams*, whereby the *Sensation* becomes more strong and vigorous.

VIII.
Air is ne-
cessary for
the convey-
ing of the
Odorous
Exhalations.

The *Sense* of *Smelling* cannot be performed without *Air*, wherewith the *Odoriferous particles* being mingled, they are drawn in by the *Nostrils*. For *Air* is the most proper *Medium* for the diffusion of *Odours*; not only because it is of absolute necessity to *Respiration*, but also because the *Odour* is both further and more easily diffused and transmitted thereby. Accordingly we see, that the stench of *Carkasses* is mostly carried towards that part whither the *Air* is driven by the *Wind*. For this is the Nature of this, as well as of all the other *Senses*, that except the *Organ* it self be struck upon, no *Sensation* is effected; for the *Organ* of *Smelling*, must be struck with the same Force wherewith the *Air* is drawn in. For the *Air* being the Vehicle of the *Odoriferous Exhalation*, a good part of it is let down into the *Wind-pipe*, whilst the other more affecting a streight motion, enters the *Nostrils*, and dasheth against the *Organ* of *Smelling*; which *Odoriferous Steam* is so long perceived, as the *Air* is drawn in by the *Nostrils*, and ceaseth to be felt, when it is breath'd out again. The Reason whereof is, because the *Pipes* and *Passages* in the *Nostrils*, which are opened by

drawing-in of the *Breath*, and the Entrances whereof are towards the end of the *Nose*, are shut again upon the breathing-out of the *Air*, and consequently it is necessary that thereupon the *Sense* of *Smelling* should be intermitted, and all sensible Impression upon the *Organ* cease. Whence it is easily understood, why one that hath a *stinking Breath* doth not perceive the *smell* of it himself, whilst he breaths it out through his *Nostrils*; because the hollow *Passages* of the *Nostrils* are shut up, and *Odours* cannot be received contrary to the Course or Grain of the *Fibres*.

The *Odoriferous matter* cannot be perceived, except it be at some distance from the *Nostrils*; because when there is a due Distance, the *Terrestrial Particles*, which are always in great abundance mixed with the *Air*, are the more easily dissipated and disperst: As a *Sword* must be unsheathed before it can do any Execution; and an *Arrow* must be taken out of the *Quiver*, before it can make a wound. For the abundance of *Evaporations* do too much agitate the *Nerves*, subservient to the *Sense* of *Smelling*, and by stopping up their *Pores*, hinder the supervening *Steams* from penetrating them. Hence it is, that an *Odour* that comes from far, is more grateful and pleasant, because those *Heterogeneous* and *Grosser particles*, which are mixed with the *Odoriferous steam*, do by degrees sink downwards, leaving the rest pure and unmixed; which entering the *Nostrils*, produce a purer and more refined *Scent*.

Forasmuch therefore as every *Odour* is a *Steam*, which exhaling from the *Odoriferous Body*, and being diffused through the *Air*, doth move the *Organ* of *Smelling* in the *Nostrils*, after a certain determinate manner, and with Force enough, it may be easily understood, what is the chief Cause of the variety of *Odours*. For seeing that these *Steams* consist of almost innumerable *Filaments* (of which we have an Example in the *Steam* of a *Candle* newly extinguish'd) which may be variously crooked and bent, it cannot be question'd but that according to the variety of their *Particles*, they do more or less move the *Odoratory Nerves*, and thereby give occasion to the *Soul*, of perceiving great diversity of *Odours*: So as that those *steams* produce grateful and sweet *Odours*, whose *Motions* are very moderate, and duly temper'd together; and those on the contrary produce loathsome *Smells*, which are more vehemently agitated, or else whose Motion is too dull and slow. For those *Bodies* that do not strike the *Organ*, and in some sort press upon it, cannot excite the *Sense* of *Smelling*.

That we may be deceived in the *sense* of *Smelling*, is evident from divers instances. For *CARDAN* in his 8th Book de *Varietate Rerum*, Chap. 43. declares, that he always perceived the *Smell* of something or other in his *Nostrils*, as sometimes the smell of *Flesh*, sometimes that of *Frankincense*, and at other times the smell of some other thing. *LEWIS XI.* in his *melancholy fits*, conceited that every thing that was about him had an ill smell. There was also a French Poet that was a very melancholy Man, who being sick of a *Fever*, and persuaded by his *Physicians* to have his *Temples* anointed with *Unguentum Populeum* to make him sleep, conceived such an aversion for it, that for many years after he imagined that every thing

IX.
The Odo-
rous Object
is to be at
some di-
stance
from the
Organ.

X.
What a
Smell or
Odour is,
and whence
diversity
of Odours
doth pro-
ceed.

XI.
Deceptions
of the sense
of Smel-
ling.

that was about him, smelt of it. There have been some persons likewise (as BARTHOLINE informs us, *Hist. Nat. Centur.* 4.) that could smell things that smelt well, but not such as did stink, or had an ill smell. The same Author tells us of an Apothecary, who had lost this sense, by the too frequent use of Camphire. And SCOTUS *Phys. Curios.* Cap. 33. gives us an account of a Woman, who never could smell any thing.

C H A P. XV.

Of the Sense of Hearing.

I.
What the
Sense of
Hearing is.

HAVING spoken of the Senses of Feeling, Tasting and Smelling, we next proceed to handle that of Hearing. Now Hearing is an External Sense, whereby an Animal, with the help of his Ears, and the Nerves implanted in the Cavities thereof, receives Sounds. Or more plainly, Hearing is that Sensation, whereby from a due motion of the small Fibres of the Auditory Nerves, imprest upon the Ears, and conveyed to the Brain, or common Sense, the Soul perceives Sounds, and judgeth of them. For Hearing, as well as every other Sensation, is founded upon the help and mutual concurrence of Soul and Body. For in this Sense the Presence and Action of the Soul is required; because when the Soul is otherwise employ'd, the Excitation of Sounds signifies nothing to it, tho' they be never so loud and violent; for then tho' the Ears be open, yet no sense is perceived, because of the inadvertence, and want of Attention in the Mind.

II.
The Usefulness of this
Sense.

This Sense is more Excellent than any of the foregoing, and is equally necessary to Man, and other Animals. For seeing that many things at a distance might attack Animals, to their great hurt and prejudice, except they were timely forewarned of them, Nature hath furnisht them with this Sense of Hearing, whereby they are forewarned to avoid things inimical, and to prosecute such are grateful and suitable to them. Moreover Hearing is of the Highest and most Necessary use to Man for the accomplishing of his Mind, as ARISTOTLE speaks in his *Treatise, De Sens. & Sensili* Cap. 10. For seeing, saith he, that in this short term of life that is allowed us here, we have not leisure enough to search into the nature of all things, this Sense gives us the advantage of being instructed, by listning to the informations of Learned Men, whereby we are taught our Duties, and how we are to behave our selves, not only in a Civil Society, but also in our private and Household concerns. For by the Company and Conversation of Learned Men, we attain the knowledge of Sciences, and are admonished how we may become both Wise and Prudent.

III.
The parts
that belong
to the Organ of
Hearing.

Before we can thoroughly understand by what means this Sense is produced, it will be necessary for us to know the structure of its Organ, and the principal parts that compose it. The outward Lappet of the Ear, which is formed by Nature for the collecting of the sound, and receiving its first impulse, consists of the flap or lappet and the Gristle of the Ear; this part, which hath a pretty large compass, is by degrees straitned, till it ends in the Hollow of the Ear. Next after this

outward Cavity follows the Passage, or Auditory Cave, which is crooked and turned into several windings, to the end that the sound, which is carried with the Air, may be encreased by insinuating it self into them. This Winding Hole leads to a most thin and dry Membran, which is terminated by, or enclosed with a Bony Circle, which is commonly called the Drum of the Ear, because it obliquely admits the impulse of the Air, being struck with the sound. To this part 3 small Bones and a Muscle are joined, viz. the Hammer, the Anvil and Stirrup, which all 3 hang together; for the Hammer is jointed into the Anvil, and the Anvil into the Stapes or Stirrup. The Cave wherein the foresaid little Bones are found, is by some called Concha or the Shell, and by others Pelvis or the Basin; which is large enough, and in a manner of a round figure, and leads to a vast number of little Cavities. Which Cave, with all its annexed Cavities is not empty, but filled with Air, which some call Inborn, but wrongly, forasmuch as it is frequently changed, as appears from the free and open passage the Air hath to them.

These things premised, it will not be difficult to understand in what part of the Ear Hearing is produced. For it is apparent, that it cannot be effected in its outward Cavity, because the outward Ear is only like a Funnel, through which the shaken Air may the more freely enter into the Auditory passage; neither is this Sense performed in the Auditory Cave or Hole, seeing that the same seems only to have been framed by Nature, for the conveying of the sound, and for the perpetual out-flowing of the steam. Neither is it effected by the little Bones, for seeing that they want Nerves which are the Organs of all the Senses, neither can they be supposed to transmit the sound to the Brain. It remains therefore, that the same be performed in the Auditory Nerves that are latent in the said little Cavities, there being 2 Nerves hid within the said Cavities, which receive all the shakings and agitations of the adjacent Air; by means whereof the representation of sound is communicated to the Soul. For the Air by shaking the Membran of the Drum, doth at the same time move the 3 linked Bones, to which these Nerves are joined: which tremulous impulse being conveyed to the Brain, by the help of the foresaid Nerves, do give an occasion to the Mind, of conceiving the Idea of Sound.

Sound is a tremulous and waving motion of the Air, whereby some part of the Air, being whirled into certain Circles, is most swiftly waved this way and that way. These Circles are framed by the Body that strikes or shakes the Air, as a Bell, a String, or a Tongue, much after the same manner as we find that Circles are formed in the Water when Stones are cast into it, which at first are small, and afterwards swell greater, one part of the beaten Water, driving and pushing on the other. And like as these Circles tend more towards that part whither the stream of the River tends; so the Wind carries the Sound towards that part, whither it drives the Air. Yea as oft as the Wind, being hindered in its course by meeting with some solid Body, is forced to make a Circle, by waving backwards and forwards (as the water makes a Whirlpool, when ever it is hindered in its

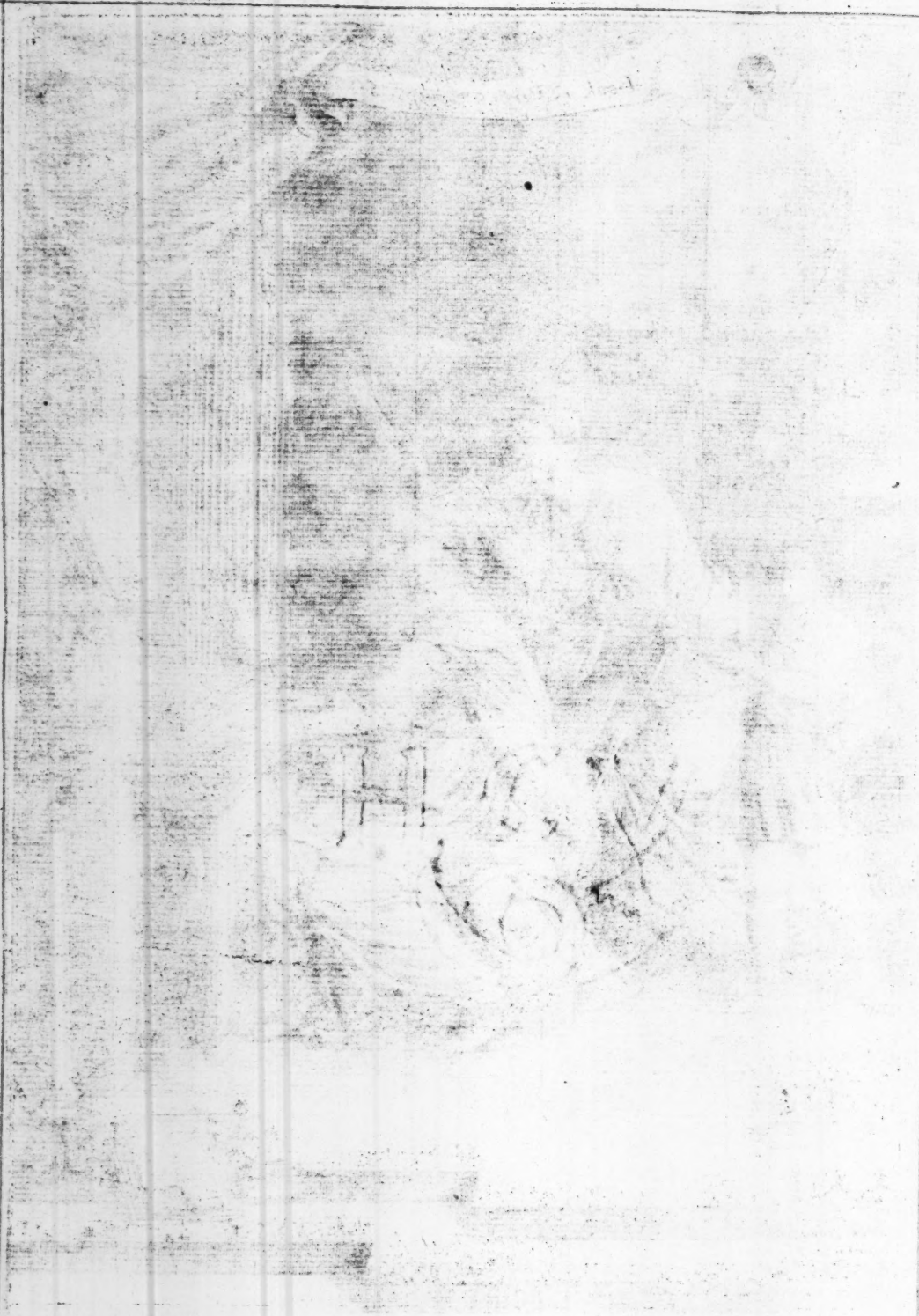
IV.
By what
Instruments
the Sense of
Hearing is
performed.

V.
What
Sound is,
and how it
is formed.



G. Freeman In:

M. Vander Gucht. sc:



strait progress) so often is the *sound* heard, which operation is little different from that which forms an *Eccho*.

VI.
Whence the
variety of
Sounds doth
arise.

The Differences of *sounds* proceed from the Diversity of *motion*, as well in the *sounding Body*, as of the *Air* that is agitated thereby. For that the *strings* of a *Cittern* do give so much a sharper and quicker *sound*, the more that they are stretched, and wound up higher; and the *lower* and duller, as they are less stretched; is only because the motion of *Cords* that are high wound is more swift, and consequently impresseth a swifter *motion* on the *Air*, than that which is but slack. And therefore the *sound* is said to be shrill and sharp, when the shakings or beatings of the *Air*, be more frequently reciprocated, and the *Organ* more swiftly struck by them: and it is accounted a low or Deep *sound*, when the *Vibrations* of the *Air* are less frequent, and the *Organ* is more leisurely struck with the impulses thereof. So that all the Difference there is betwixt a *high* and *Deep sound* is this, that in a *High* or *Sharp sound* the parts of the *Air* beat more frequently and fast upon the *Organ*, whereas in the *Base* or *Deep Sound*, the Concussions admit of longer *Intervals*; as is evident in a shorter *string* wound up to the same Height, and of the same Thickness, compared with a longer, because the former will yield a more *high* or *shrill sound* than the latter, forasmuch as it affords more frequent *Vibrations*, and beats the *Air* and *Ear* with quicker repeated *strokes*.

VII.
The Causes
of the
Harshness
and Sweet-
ness of
Sounds.

In like manner we find a *sound* to be either *harsher* or *sweeter*, according as the *Beatings* or *Wavings* of it are more or less equal. For if the surface of the *Body*, whence the *Sound* or *Air* is reflected, or driven back, be *rough* and *rugged*, the *sound* is more *harsh*: For the ruggedness of the surface, causeth some *particles* of the *Air* to be pulst away sooner, and others later, as passing through an unequal space; wherefore it is necessary that some of them must come to the *Ear* sooner than others. And for this Cause it is that a *Trumpet* that is not very polisht and smooth, doth give forth a more *harsh sound*. Whereas a *grateful* and *pleasant sound* consists in the equality of every *Undulation* of the *Air*, beating against the *Ear*, because in this case that whole portion of the *Air*, arrives at the *Organ*, at the same time, and strikes it with an even *motion*.

VIII.
The Air
is the
Medium
that trans-
mits Sounds.

The *Air* is acknowledged by all *Philosophers* to be the *Vehicle* of *Sounds*, which proceeding by a waving *motion* from the *Sonorous Body*, doth impress that Affection upon the *Organ*, which is called the *Act* of *Hearing*: For since the *Air* is in continual *motion*, it is easily determined by the *Body* that is stricken, to produce a *sound* in us. I am not ignorant that some famous *Modern Authors* are of opinion, that the whole *Atmosphere* of the *Air* is not the *medium* for the transmitting of *sounds*, but only the most pure part of it; founding their Sentiment upon this Experiment, that every *sound*, be it great or small, whether it be carried before or against the *Wind*, yet doth always, in an equal measure of time, pass through an equal space of *place*, which could not happen so if it were conveyed by the *undulating motion* of the entire *Body* of the *Air*.

IX.
The Sound
sooner or la-
ter arrives

But I cannot altogether assent to this assertion; for tho' a *sound* may be heard by 2 *Men*, stand-

ing at an equal distance from the *Center*, at the same time, notwithstanding that the *Air* blow violently, yet cannot it be inferred from thence, that the *sound* doth not depend upon the *Undulation* of the *Air*. For tho' it be true, that a *Body* that is swiftly moved, cannot be carried by that which is more slowly moved; yet is that *Body* to be excepted from this general *maxim*, which upholds and supports another. For let us suppose, that whilst a *Globe* doth move upon a *Table*, the *Table* also with a very slow *motion* moves towards it, it cannot be questioned but that in this case the *Globe* doth participate of the *motion* of the *Table*: In like manner those small *particles* of the *Air*, which convey the *sound*, must more leisurely transmit the same to the *Ear*, if the *Wind* be contrary. But that 2 *Men* in an equal distance from the *Center*, do both bear the *sound* at the same time, this is to be imputed to the *sound* it self, which being most swift in its *motion*, the difference of time seems to be insensible.

Moreover, they who alledge the forefaid Experiment, do acknowledge, that the *sound* is heard fuller and plainer by him to whom the *sound* is conveyed by the *Wind*, than to him to whom it comes against it. If this be true, we know that the *Wind* cannot make a greater *sound*, except it carry the *particles* of *sound* along with it, which it cannot do without moving them; neither can it move them, but that it must accelerate or hasten them, and cause it to come more swiftly to the *Ear*. Let us conclude therefore, that *Sonorous Bodies* do shake the whole circumambient *Air*, or rather determine it, as being already in *motion*, to tend to some particular part. And therefore that not only the thin and subtil *Air*, is the *vehicle* of the *sound*, but also that which is thick and full of *vapours*. This manifestly appears in the *Pneumatick Engin*, for when the *Air* is wholly drawn out of it, the *motion* of a *Watch* can scarcely be heard in it. Which Experiment doth evidently demonstrate, that the gross *Air* doth conduce much to the conveying of the *sound*, and promotes its propagation.

Forasmuch therefore as the *sound* is diffused, as it were along every line, from the *Center* of a *Sphere*, towards the *Circumference*, it may so happen that the *particles* of *Air*, that are on their way to convey the *sound* to others, may meet a hard *Body*, and being unable to penetrate or agitate the same, are forced to turn back and be reflected, and to rebound their *motion* to those parts whence they had received it, and those again to others, and so on. By which means it comes to pass that the same *sound* is heard again, being several times repeated, which is called an *Eccho*. For *Sound* as well as *Light*, is subject to Reflexion, and when-ever a smooth and hollow hard body is interpos'd, it rebounds; but yet with this difference, that a *sound*, because of the slowness of its *motion*, cannot advance far in one *Moment*, but wants a longer space of time for its diffusion. And therefore the further the person that receives the *sound* is distant, from that *Body* that reflects it, the more time the *voice* in rebounding takes up: whereas the *Light* in one moment of time reflects from several *Bodies*, and enlightens many places at once. If the *sound* meet with divers *Bodies*, at different distances from each other, that are proper to rebound it, there follow many Reiterations of

to the Ear.
according
as the wind
is for it or
against it.

X.
A Sound is
better
heard with
the wind
than a-
gainst it.

XI.
How an
Eccho is
formed.

F f f f

the

the same Voice, viz. when the former sound being vanisht in the neighbouring Air, another is formed by the Air that is more remote; which being afterwards beaten back from Opaque and Hard Bodies at a greater distance, doth again shake the neighbouring Air, and that either once only, or more frequently. Yea an *Eccho* sometimes happens in Bodies that are very near, as in the Tiles of Houses; as when a Voice directed from a high place, and level with the Tiles of the Houses, enters the hollow that is under the said Tiles, and from thence rebounds towards the Speaker, whence it proceeded.

XII.
The Hearing is subject to some Deceptions.

Many mistakes may happen to the Sense of Hearing, as well as to the other Senses, which are not imputed to the inward Affection it self, but to the Cause of it. Thus a Buzzing Sound, or Noise in the Ear, which is commonly attributed to the External Object, hath no other cause, but that some part of the Steam, or the inclosed Air, or a swelling in the Muscles of the Ear, affecting the Organ of Hearing, stirs up some undulating motions: wherefore it is that Sick People, because of some corruption of their Blood, or by reason of some Excrements that cause an obstruction in the Ear, do frequently complain of this noise in their Ears. Another mistake or Deception in the Sense of Hearing is, when upon cutting off of the Lappet of the Ear, the Sound is received like to Water running down from on High; for when this outward Shell or Hollow is taken away, the Sound enters straight into the Auditory Cave, and wants that due determination it should receive from the outward part of the Ear: For the Ear-lappet, as before said, was framed by Nature, for the collecting or gathering of the Sound; wherefore when that is wanting, the Sound immediately enters into the Basen, as if it came from several parts, as it happens in the noise of running Water. Neither are we to forget that mistake, which we are sensible of when we stop our Ear, for then we perceive a kind of tremulous Buzzing or Noise, as if the Air did role about in the Ear; the reason whereof can be no other but this, that the Steam is continually passing out of the Ear, which being hindered from coming out, it pulseth against the Organ of Hearing, whence this noise doth arise, which we suppose to be inward.

As I was not long since with some Friends going upon the Thames, between the two Churches of Fulham and Putney, it hapned they were ringing Fulham-Bells, the sound whereof was so rebounded from the opposit Church, that it seemed equally to proceed from both places; neither was it easie for us to determin whence it came, so that we had various disputes about this Deception, being much affected with the Diversion it gave us.

CHAP. XVI.

Of the Eye.

I.
What the Eye is.

Forasmuch as the Eye, is the Organ of Sight, and that within the Recess or Hollow thereof, the Images of the several Objects are represented, we shall never be able throughly to understand how Vision or Sight is effected, without describing the disposition and structure of its parts. The Eye, therefore, is the outward Organ of Sight,

through the Transparent parts whereof the Rays of Light pass, till they arrive at the Net-work-coat or Membran, and there variously moving the small Capillaments of the Nerves, suitable to the variety of Objects whence they proceed, do represent or portray the Image of the Object. The inward Organ of this Sense are the Optick Nerves, which reach from the Net-work-like-membran to the Brain, and receiving the motion from the said Membran, convey it to the common Seat of the Senses.

And to the end we may more exactly apprehend all these particulars, suppose we an Eye cut through in the midst, but yet with that Art, as that all the several Humors contained therein, keep the same place they had before, without any part of them being spilt; and then it would appear to be of the same Structure, as it is represented in this Scheme, wherein D B, C B D, set forth its round Figure, that marked B C B, being the forepart of it, and B A B, the other part, which is enclosed within the Bone of the Head.

B C B, is a hard and thick Membran, which the Physicians call the Horny Coat of the Eye, being, as it were the Vessel and Receptacle to contain all the other parts of the Eye; and this part is transparent, and more prominent or convex than the Remainder, to which the Rainbow, so called, belongs, which almost is of different colours in all Men. It sticks out forwards, because if it were more flat, the Beams which slantingly touch its surface, would scarcely ever reach the Bottom of the Eye, through the entrance of the Apple thereof; so that we should only perceive a very small part of the Hemisphere at one cast of the Eye.

DEF, is a thinner Membran, stretched out like a Hanging or Tapisstry, and is called the Tunica Uvea or Grape-like Coat, for that it is perforated like a Grape when the Steele is pluckt out of it. In this Membran or Coat is a small hole, the Apple of the Eye, in the midst of the Rainbow, marked out by the Letters FF, called in Latin Pupilla, because in it a Baby or little Image is represented by the Rays that are reflected from the surface of the Eye, to every one that looks upon the Eye of another. The Apple of the Eye, in a Man, appears Black, because that part of the Coroides, or the Grape-like Coat, which answers to it, is of that colour. The contexture of Fibres rang'd in a circle, and which outwardly is placed about the hole of the Apple of the Eye, being diversified with various colours, is called the Rainbow.

NN, are many black Filaments, called Processus Ciliares, which do every way furround, and gird in a certain soft and transparent Body, called the Crystalline Humour, and keep it suspended in the midst of them.

The space contained betwixt EKE, is filled with another transparent Humour, which is therefore called the Watry Humour, because in all respects it is like Water. This Humour gives the Round Figure to the Eye, refracts the admitted Beams, and in this disposition imparts them to the Crystalline Humour. The Eye continually receives of this humour by some particular Vessels which are in the Sclerotica, which is a part of the Horny Coat or Membran, and which are inferted into it, near to the Apple of the Eye, whence

II.
Of the Figure of the Eye.

Figure 68.

III.
What the Horny Coat of the Eye is.

IV.
The Uvea or Grape-like Coat, and the Apple of the Eye.

V.
The Ligaments of the Eye.

VI.
The Watry Humour.

it

it is that when the *Horny membran* is pierced, and the *Watry Humour* by this means is spilt and let out, the said loss may be repair'd in the time of a few *Hours*.

VII.
The Cry-
stallin
Humour.

The Mid-part *L*, is a certain transparent *Sub-stance*, rather of the figure of a *Lentil*, than *Spher-ical*; for the greatest part of it is cover'd by the *Rainbow*, and the Fore-part of the greater *Round*, is less than the other, and the Hind-part of the lesser *Round*, is the biggest. It is because of its Compactness and some appearing Hardness, called the *Icy Humour*, but more commonly the *CrySTALLIN*. This *Humour* is white, like *Starch*, and is of the consistence of *Wax*, which melts, and may be compress'd, but cannot be spilt.

VIII.
The Glassy
Humour.

The remaining Hollow of the *Eye G M I*, is taken up by a *whitish Humour*, more transparent than the *CrySTALLIN* or *Watry*, and of a mean consistence betwixt them both; because it can more easily be contracted and displayed; and yet it is not so liquid, or thin and flowing, as the *Watry Humour*. It is commonly called the *Albuminous* and *Glassy Humour*, because it hath the consistence and colour of the White of an *Egg*, and is transparent like *Glass*. This *Humour* rests upon the *Network-like Membran*, and contains in it self the *CrySTALLIN*; it is enclosed in a very thin *Membran*, which keeps it from spilling.

IX.
The Cry-
stallin Hu-
mour causeth much
the same
Refraction
of the
Rays, as
Glass doth.

Experience informs us, that the *CrySTALLIN Hu-mour* causeth much the same *Refraction*, as *Glass* and *Crystal* doth; and that the two other *Humours* produce somewhat a less *Refraction*, and much about the same as *Common Water*: So that the *Rays of Light* pass more easily through the *CrySTALLIN Humour*, than through the two other *Humours*; and yet more easily through these, than through the *Air*.

X.
The Optick
Nerve.

H Z, is the *Optick Nerve*, which takes its rise from the Hinder-part of the *Brain*, not far from the beginning of the *Back-bone*, the *Capillaments* whereof *G H I*, being dispers'd throughout the whole Space *A B H*, do cover the whole bottom of the *Eye*, constituting a sort of a most fine *Net*, which from its Expansion is called *Retiformis*, or *Net-work like*, and *Retina* by *Physicians*. Now these *Capillaments*, by means of the *Convex figure* of the *Eye*, and of the *CrySTALLIN Humour*, do collect the *Beams*, and communicate the *motion* they have received to the *Brain*, and present it to the *Soul* that resides there.

XI.
Why the
Surface of
the Coats
of the Eye
is black.

My design is not to reckon up here all the *Coats* that enclose the *Eye*, seeing that the knowledge of them doth not conduce to the understanding of the *Sense of Seeing*; and therefore shall only take notice, that the *surface* of these *Coats* is wholly obscure and black in those *Parts* that face the bottom of the *Eye*; and this, to the end that the *Rays* which fall upon the *Net-like Coat G H I*, and from thence are reflected to the *Grape-like Coat*, might be extinguish'd by that *Blackness*, lest being again reflected to the *Retina*, or *Net-like Coat*, they should disturb and confound the *Sight*.

XII.
The six
Muscles
of the
Eye.

O O, are six *Muscles*, outwardly fastned to the *Eye*, by the help whereof it can readily move it self every way. Of these *Muscles* 4 are called *Direct*, whereof the first lifts the *Eye* upwards, the second turns it downwards, the third draws it towards the *Nose*, and the fourth withdraws it

to the opposite part from the *Nose*. The other 2 are called *Oblique* or *Slanting*, because they encompass and surround the *Eye*; for with the one of them the *Eye* is enabled to give a slanting or oblique *Cast*, and with the other it is rolled round.

When the *Right Muscle*, which is above the *Eye*, is fill'd with *Animal Spirits*, the *Eye* looks up; and the 3 other *Muscles* being fill'd in like manner by turns, assist it sometimes to look downwards, and sometimes to turn it to the *Right* or *Left*. Besides, it is evident by the situation of these *Muscles*, that when all of them are shortned, they at the same time alter the figure of the *Eye*, by making it more flat than it was before.

That part of the *Eye*, which is marked *B C B*, is of a *Convex figure*, to the end that the *Rays* proceeding from the *Objects*, which of themselves have not force enough to enter the *Apple* of the *Eye F F*, might be united by a various *Refraction*, and by this means might have force enough strongly to move the *Hairy-strings* of the *Optick Nerve H Z*. For the *Refraction* which is made in the *CrySTALLIN Humour L*, procures strength and distinction to the *Sight*.

Besides, this is to be observed, that the *Apple of the Eye* is liable to *Contraction* and *Dilatation*, according as the *Objects*, to which the *Eye* is directed, are nearer or farther off; or more or less enlightened; or according as the *Beholder* doth more intently or carelessly view the *Object*. For this *Coat* hath the power to dilate or narrow it self like a *Muscle*, and by this means to enlarge or contract the *Apple of the Eye*, viz. by stinting the entering of the *Rays*, and by causing more or less to pass through it.

Wherefore this *motion* may be called *Voluntary*, tho' for the most part it happen without our *Attention*; for it doth nevertheless depend on our *Will*, or on those *motions* which do accompany the *Will* or desire of thoroughly beholding any *Objects*. In like manner as the *motion* of the *Lips* and *Tongue*, conducing to the formation of *Voices*, is called *Voluntary*; because it is consequent to our intention of *Speaking*, tho' we do not mind, yea, and are ignorant also, what kind of *motion* every *Letter* requires.

CHAP. XVII.

Of Colours.

FORasmuch as *Colours* are the *Objects* of *Seeing*, we are to consider what they are, and wherein their *Nature* doth consist, before we undertake the Explication of the *Sense of Seeing*. We suppose therefore in the *First* place, that no *Colour* can appear without *Light*, and that consequently *Colours* are nothing else but certain *Alterations* or *Modifications* that happen to the *Light*. Secondly, that even *Transparent Bodies* also, appear distinguish'd with various *Colours*, if the *Light* that falls upon them be variously reflected to the *Eye* of the *Beholder*. As may be seen in a *Round Ball* of *Glass* fill'd with *Water*, in the *Bubbles* that *Children* sport themselves with, in a *Prism*, in the *Rain-bow*, and in other *Bodies*.

We

XIII.
How the
Right or
Direct
Muscles
serve to
move the
Eye.

XIV.
Why the
Apple of
the Eye is
of a Con-
vex figure.

XV.
The Apple
of the Eye
can be
contracted
and dilated.

XVI.
The Motion
of the
Apple of
the Eye is
voluntary.

I.
Colour is
nothing
else, but a
Modification
of
Light.

II.
What Light
and the
Beams
thereof are.

We must also suppose the *Light* to be the *Action* of a *Subtil matter*, the Parts whereof, as so many small *Pellets*, do roll continually through the *Pores* of *Earthy Bodies*: So that there are innumerable *Rays* or *strait Lines* by which this *Action* is communicated, which proceed from the several *Points* of a *Lucid Body*, and reach to the several *Parts* of the *Body* which they enlighten.

III.
That in-
numerable
Rays pro-
ceed from
every
Point.

For we are to conceive, that there is no *surface*, how polish'd and smooth soever it may appear to the *Eye*, but is really rough and unequal; so that every *Point* assignable in the outside of the most smooth *Body*, is to be imagined like a little *Hillock* or *Prominence*, from whence innumerable *Beams* may be dispersed round about. For otherwise, if the *surface* of any *Body* were altogether polish'd and smooth, it could not shed the *Rays* round about, but only directly to the opposite side; so that the *Object* would only reflect such direct and *Parallel Rays*, as could only reach to the *Eye* obliquely or slantingly placed.

IV.
The Rays
of Light
may be
reflected
after di-
vers man-
ners.

Moreover we are to take notice, that tho' the *Rays* pass strait along through *Transparent Bodies*, yet they are easily turned aside by others they meet with; much after the same manner as a *Ball* struck against a *Wall*, rebounds variously, according to the difference of the *Surfaces* it lights against. For it rebounds otherwise from a *plain* and even *Surface*, than from a *crooked*; and otherwise from a *hard*, than from a *soft*: For being struck against a *soft Body*, it loseth its *motion*; whereas lighting upon a *hard*, it rebounds immediately.

V.
The Rays,
besides
their mo-
tion in
right Lines,
may also
be moved
round.

Lastly, We are to take notice, that as a *Ball*, besides its *motion* whereby it tends from the *Hand* to the *Wall* in a right *Line*, and from thence rebounds elsewhere, is capable also of being moved round its own *Center*: So likewise the *Rays* of *Light* cannot only move to right *Lines*, but may be so reverberated by the *Bodies* they light upon, as to take upon them a *Circular motion*, wholly in the same manner as a *Ball* struck by a *Racket*, rebounds against the floor or ground.

VI.
What Co-
lours are.

From what hath been said, it follows, that *Colours* are not in the *Coloured Bodies*, but are only such a disposition, which either swallows up the *Rays* of *Light*, or variously reflects them to the *Eye*, and according to the diversity of this *motion*, doth differently affect the most subtil *Organs* of the *Sight*, and by this means produce a *Sense* of *Colours* in us. So that *Colours*, as they are assignable to *Bodies*, are nothing else, but different *Modes*, according to which *Bodies* receive the *Beams* of *Light*, and either drown them, or with great variety reflect them to the *Eye*.

VII.
Wherein
the Nature
of Colours
consisteth.

Let us suppose therefore, that there are some *Bodies*, which when they are struck with the *Beams* of *Light*, do choak them, and break all their force; and such are those that are of a *Black Colour*, which is common to them, and *Darkness*. That there are also other *Bodies* that reflect the *Beams*, some of them in the same manner as they receive them, viz. such *Bodies*, whose *Surface* being exactly polish'd, serve for *Looking-Glasses*. Others, which reflect them confusedly this way and that way; and again, that amongst these some reflect these *Rays* so, as that the *Action* of *Reflection* is not spoiled by any the least alteration, viz. those *Bodies* that are of a *white Colour*. And

that others again produce a Change like to that which happens to the *motion* of a *Ball* that is struck with a slanting *Stroak* of a *Racket*; and such are the *Bodies* that are of a *Red, Yellow, Blue*, or other *Colour*.

For when the *Rays* of *Light* are sent forth from a *Lucid Body*, the *Globuli* of the second *Element*, which constitute those *Rays*, are either evenly or unevenly driven forwards, and whirl'd about by a different *Proportion*; because of the various *Nature* and *Constitution* of the *Bodies* they meet with. And from this proportion of their direct *Motion* and *Circumvolution*, all *Modifications* of *Light*, or *Colours* do proceed. This is evident in *Transparent Bodies*, in which many *Colours* do appear, whereof no other Cause can be assigned, besides those different *Modes*, according to which the *Beams* of *Light* are admitted. As may be seen in the *Rainbow*, *Peacocks-Tails*, and in the *Necks* of *Doves*; forasmuch as these *Colours* cannot be said to be any thing else, but the *Light* itself received in the outward-parts, and so or so reflected and conveyed to our *Eyes*. For all the *Particles* of *Light*, that enter a *Transparent Body*, are not drowned or swallowed up of it, but many of them rebound, which by means of various *Reflection* and *Refraction* reaching our *Eye*, do produce in us the *Sense* of *Colours*.

This will appear clearly to us in the *Prism* M N P, 2 of the *Surfaces* whereof, M N, and N P, are entirely plain or flat, and so inclined the one towards the other, as to constitute an *Angle* of about 30 or 40 Degrees; and therefore if the *Rays* of the *Sun* A B C, that light perpendicularly upon the *Surface* N P, do penetrate or pierce it obliquely about the *Hole* D E, which exhibits a *Shadow* at both parts of the said *Hole*, to the *Rays* D F, and E H, passing through it; it is manifest by Experience, that the *Rays* passing obliquely through that *Hole*, from the *Glass* into the *Air* will be refracted, and reaching the *Surface* H G F, (which we suppose to be *White*) they will exhibit divers *Colours* from H to F, and that in this order: In the first place they will represent a *Blue* or *Violet Colour* about H; then a *Green*; in the 3^d place, a *White* about G; 4^{thly}, a *Yellow*; and 5^{thly}, a *Red Colour* about F.

Now what happens in this Production of divers *Colours*, but only this, that the *Globuli* of those *Rays*, which after the same manner of Inclination, falling upon the lower *Surface* of the *Prism* N P, on the Left hand towards D N, have a *Shadow*, caused by the slow motion of the *Globuli* of the 2^d *Element*; whereas on the Right, towards E P, they have a *Light*, caused by the swift motion of the said *Globuli*; which causes them to move more swiftly about their own *Centers*, than they do in a *Right Line*.

For the better understanding whereof, let us suppose a *Ball* 1, 2, 3, 4, so struck from V to X, as to proceed only in a right motion, and that 2 of its Sides 1 and 3, with equal swiftness fall down to the *Surface* of the *Water* Y Y, where the motion of the Side 3, which reacheth that *Surface* before the other, is retarded, that of the Side 1 being not changed at all; whereupon the whole *Ball* begins to roll about, according to the order of the *Figures* 1, 2, 3. Now this *Circumrotation* will be much swifter, than its progress, in case the *Ball* S, being

VIII.
Colour is
nothing
else, but a
Modification
of the
Rays of
Light.

Figure
69.

Figure
70.





*To the Worship =
Upton of
County of Devon*



*full William
Lupton in the
Esq.*

This Plate is humbly

Dedicated by Richard Blome.

being moved more slowly than it, and lying beneath it, about the part of the Ball 3 2, chance to stop its progress; and that Ball Q, plac'd above it, about the part 4 1, being more swiftly moved, do forceably push it forwards, and by this means make its rolling about to be much more swift than its Progress. But if the Ball 1 2 3 4, falling slantingly from V, on the surface of the Water Y Y, towards X, and first touching it with its Point 3, do roll about slowly, according to the order of the Numbers 1 2 3 4: I say, if this suppos'd, it have on the Side 1 the Ball R, moved more slowly than it self, and thereby hindring its whirling round; and on the Side 3, it have oppos'd to it the Ball T, more swiftly moved than it self, it will by this its more swift motion retard the Ball 1 2 3 4, striving to whirl it self about, according to the Series of the foresaid Numbers, and so will make its Circumrotation much more slow, than its progress.

IX.
Whence the
difference
of Colours
doth arise.

Figure
69.

These things being well observed, we shall easily understand, that by how much nearer the Rays of Light, passing through the Hole D E, do approach to the Left Shadow D, by so much greater will be the whirling about of the Globuli of the 2d Element, than their Progress: Whereas the nearer they approach to the Right Shadow E, they are whirled about so much more slowly, than they move fore-right. We understand likewise, that those Globuli which intersect the middle of that Light about G, have an Equal proportion of Retardation or Acceleration of their Circumrotation and Proceffion. And seeing that we find the White colour represented there, we must conclude that Whiteness consists in that Proportion: But that the Nature of the other Colours, as of Blue, Yellow, Green, Red, consists in the different swiftness or slowness of their whirling about, exceeding that of their Process, or moving forwards.

X.
All Colours
are true
Colours,
and none
only appa-
rent.

I am not ignorant, that most Men distinguish these Colours from true ones, and call them Apparent only; but these do not seem to understand the genuine Nature of Colours, which consists only in this, that they appear and are conspicuous. For it is a contradiction, that any thing should appear and be false. All Colours therefore are the effect of Light, variously reflected from the Surface of Bodies, suitable to the situation of their outside Particles, their whole difference consisting in the various Modes of receiving it, and reflecting it to our Eyes. Thus we call that a Black Body, which extinguisheth and choaks the Rays of Light; and therefore Black Bodies carry a resemblance of Darknes. Blue Colour, which approacheth to the Nature of Black, is that which reflects only a few Rays: And 'tis for this Reason, that Sea-water, where it is deep and transparent, appears of a Bluish Colour; because there are but a few Rays reflected from its Surface, and none of those that penetrate the Substance of it, do return.

XI.
What a
White Body
is.

A White Body is that, which reflects the Rays to the Eyes, in the same order as it receives them. Of this colour are all those Opake Bodies, whose Surface is so rough and rugged, that it reflects from all Sides the Rays it hath received parallel. So that in order to our having the Representation of a White Colour, we must receive many Rays from the Object; whereas for to see a Black Co-

lour, we must receive none at all. And therefore the Nature of Blackness must consist in a property which Black Objects have; to drown and mortifie the Beams they have received, as we have mention'd before. So that we may conclude, that those are Black Bodies, whose Surface is proper to extinguish and quash the Rays of Light; and that those are White, whose Surface hath the Property to diminish the Light, by reflecting it from all sides.

But some may Object, that Black and White Marble consist, in a manner, of the same parts, so that if one of them swallows or extinguisheth the Light, the other ought to do so likewise; and consequently, that the variety of Colours is not well grounded upon the Variety of Objects, which do variously reflect the Rays of the Sun.

To which we Answer, That true it is, that Black and White Marble do, in a manner, consist of the same Parts; but yet in the Black there are some soft Parts, which by taking in or swallowing the Light, produce a Black Colour. For Black and White Marble may be compared to a Pumice-Stone, whose Pores are filled with a kind of Oily Matter, and the White to a Pumice-Stone that is only fill'd with Air. For it may easily be understood, that when particles of Sand dash against this latter, they will rebound presently; but not from the former, because the Oily Matter, that fills its Pores, doth quash their motion, and in a manner swallow them.

That is a Red Body, which in reflecting the Rays of Light, makes the Particles thereof to whirl strongly about their own Centers, in like manner as a Ball turns round by being struck against the Earth, or with the slanting stroke of a Racket. Yellow, Purple and Green Colours, proceed, as hath already been said, from this various Rotation of the Particles about their Center. So that the Particles of the Subtil Matter, that constitute a Yellow colour, are more slowly whirld about, than those that make a Red: And those that make a Green, more slowly than those that constitute a Yellow colour: And the Purple colour is nothing else, but mixture of a Blue with a Red colour, which imparts its brightness to the former.

From all which we may conclude, That Colour is nothing else, but Light Modified; for it is evident, that a Coloured Object cannot of it self affect the Sight, as being for the most part immovable, or at least not reaching the Eye, where it is perceived; neither can any thing be thought of that moves the Eye at that time, but only the Lights reflected from the Body seen.

XII.
Wherein
the differ-
ence be-
tween
Black and
White
Marble
doth consist.

XIII.
What a
Red Colour
is.

XIV.
Colour is
nothing
else, but
modified
Light.

CHAP. XVIII.

Of the Sense of Seeing.

THE last in order of all the outward Senses, and the most Excellent of them, is the Sight; whether we consider the Object of it, or the manner whereby Objects are conveyed to the Seeing Faculty. For Sight is a Sensation proceeding from a due and various motion of the Optick Nerve, made in the bottom of the Eye, by the Rays of Light coming from an Object, and from thence conveyed to the Brain; by means whereof the Soul perceives the illuminated thing, together with its Quantity, Quality, and Modifications.

G g g g

The

1.
What the
Sense of
Seeing is
Sight is.

The *Sense of Seeing* begins indeed in the *Eye*, but is perfected no where but in the *Brain*, where the *Soul* is affected with the Impressions of visible *Objects*.

II.
What the
Object of
Sight is,
and how
many-fold.

The proper *Object* of *Sight* is every thing whereby the *Eye* becomes affected and changed, in order to the production of *Sensation*: And this *Object* is twofold, viz. *Light* and *Colour*; for these 2 cannot be perceived by any *Sense* but that of *Seeing*. And tho' some reckon up 5 several species of common *Objects*, viz. *Motion*, *Quiet*, *Number*, *Figure* and *Magnitude*; yet to speak accurately, *Light* only is the *Object* of *Sight*, whether the same proceed from the *Lucid Body*, through a transparent *Medium*, and so retain its own name; or whether it be reflected from *Opake Bodies*, and represent the *Image* of them; or whether in its *reflexion*, it be this or the other way refracted, and so affect the *Eye*, under the name and *Species* of *Colour*.

III.
The Order
of things
to be hand-
led in this
Article.

Forasmuch therefore as *Vision* or *Sight* follows from the *Action* of the *Object*, upon the inward and outward *Organs*; and since it is necessary that visible things should convey some *Images* to the *Eye*, and from thence to the *Brain*, Our Business will be in this *Chapter* to enquire; *First*, How, and in what manner *Rays* do proceed from the *Objects*. *Secondly*, How *Objects* imprint their *Images* upon the *Organ*; and *Thirdly*, How these *Images* are communicated to the *Brain*.

IV.
What Rays
are to be
considered
in Vision,
or with re-
spect to the
Sense of
Seeing.

As to the *First* of these, we are to observe, that all the *Rays* that reach the *Apple* of the *Eye*, one of them always proceeds from the *Object* that is directly opposite to the said *Apple*, which passing through the midst of it, penetrates directly, and without any *Refraction* to the bottom of the *Eye*, or the middle of the *Net-like Coat*. And this *Ray* is commonly called the *Axis of Seeing*, or the *Optick Axis*. It is also called *Perpendicular*, because it enters straight into the *Apple* of the *Eye*; whereas the other *Rays* which recede from this middle *Ray*, tho' they enter the *Apple*, yet it is only slantingly or obliquely. So that the *Cone*, whose *Axis*, is the *Axis of Vision*, is the straightest of all, the others being more oblique, as they farther recede from it. This will be more clearly apprehended by the *Figure*.

Figure
7.

Let therefore K be the *Eye* before described, and the *Object* T R X. Now it is evident that *Rays* proceed from every point of this visible *object*. But forasmuch as those *Rays* only concur to the *Sense of Seeing*, that enter the *Apple* of the *Eye*, therefore we are only to consider those *Beams* which fall upon that part of the *Horny Membran*, which directly answer to the *Apple*. Wherefore since our business here is to enquire what the *Rays* are, whereby the point R, doth affect the bottom of the *Eye*, we shall only here consider those which proceed from that point, viz. R N, R L, and the middlemost between these two, drawn from R to S.

And because the Middle *Ray* R S, is perpendicular to the *surface* or outside of the *Eye*, therefore neither doth it suffer any *Refraction* by passing from the *Air*, into the *Watry Humour*, but passeth straight from R to S; for seeing that it falls perpendicularly upon the other intermediate parts of the *Eye*; it is necessary that it be directed in like manner to S.

But forasmuch as the *Ray* R N, doth not alight perpendicularly on the *surface* of the *Eye*, and being to pass from the *Air* into the *Water*, it is manifest that therefore it must suffer a *Refraction*, by approaching to the *Perpendicular* R S, and seeing that this *Ray* is not *Perpendicular*, whilst it passeth out of the *Watry Humour*, into a *Harder Body*, viz. the *Crystalline Humour*, it must a second time be refracted, and from thence entering into the *Glassie Humour*, which is softer, it must again be turned aside; and thus still approaching nearer to the *Perpendicular* R S, after many *Refractions*, it arrives at the point S. The same is also to be said of the *Ray* R S, which after having undergone some *Refractions*, joins it self to the 2 other *Rays*, that are united in the point S. And thus it appears how the *Object* R, acts after the same manner upon the Bottom of the *Eye*, as if it sent forth one *Ray* only, that might perform the same, which all those *Beams* do that are contained between F F.

From what hath been said it will appear, what happens to those *Rays*, which from another point T, enter the *Eye*. For all the *Beams* that enter the *Eye* must undergo such *Refractions*, as that they may all of them be terminated and united in the point V. And therefore we may say, that the *Points* T R X, and any other intermediate ones, do all of them send their *Rays*, in a manner into one and the same *Point* of the Bottom of the *Eye*; and on the other hand, that every point of the Bottom of the *Eye*, receives only the impression of one *Point* of the *Object*. So that it happens, when ever we have a mind clearly and distinctly to view any *Object*, that we direct our *Sight*, or the *Axis of Vision* to every part of it successively, and so take a particular view of the whole *surface*.

Tho' the *Rays* only that proceed from *Objects* directly turn'd towards the *Apple* of the *Eye*, by passing through it, penetrate to the bottom of the *Eye*, yet may there be several other collections of the *Rays*, according to the different disposition of the *Organ*. As appears in *Old Men*, who have only a confus'd *Image* of *Objects* that are near them: And on the other hand, those that look *Aquint*, and have prominent *Eyes*, do more distinctly see things near at hand, and less exactly, such as are at a greater distance. The *Reason* of which difference is, because the *Eye* is of such a make or constitution, that according to the different distance of the *Objects* we have a mind to view, it may be extended, and so become flatter. Thus when we direct our *Sight* to any *Object*, that is too far distant, to be distinctly perceived by us, according to the ordinary constitution of our *Eye*, the *Eye* by means of the 4 direct or straight *Muscles*, is made plain or flat, because all of them draw it downwards to the bottom of the hollow wherein the *Eye* is placed; by which means the *Retina* approacheth near enough to the *Crystalline Humour*, to be present to the new Collection of *Rays* which proceed from one *Point* of the distant *Object*. And on the other hand, when we have a mind to direct our *Sight* to an *Object* that is too near to us, then our *Eye* becomes dilated by the help of the 2 *Oblique Muscles* that do encompass it, and being blown up or swell'd, by the introduced *Spirits* do press the *Eye*; whereby it comes

V.
Rays flow-
ing from
divers
points of an
Object, fall
upon so
many points
of the Re-
tina, or
Net-like
Membran.

VI.
How the
disposition
of the Eye
comes to be
changed.

to pass, that the *space* which is between the *Cry-*
stalline Humour and the *Retina*, becomes large
enough for the *Rays*, which proceed from the
Point of the near *Object*, to be again collected and
united in the *Retina*.

VII. *Why Old Men see things that are near them, confusedly; and Squint-Ey'd persons, things that are far from them.*
Old Men therefore cannot exactly perceive *Ob-*
jects that are too near them, because their *Humours*
begin to dry up, and their *Bodies* waste and grow
leaner, whereby the Convexity of the *Horny* and
CrySTALLINE Humours is diminished and so grows
flatter, by which means the *Eye* becomes some-
what broader than it was in time of *Youth*. Now
this alteration of the Parts of the *Eye*, doth not
suffer the *Rays* proceeding from a near *Object*, and
constituting the sides of *Cones*, to unite in the *Re-*
tina it self, but make them pass on as if they would
unite beyond it. Whereas those who see *Asquint*,
and have prominent *Eyes*, do but imperfectly be-
hold things at a distance; for their *Eyes* being
longer and protuberant, the *Rays* that proceed
from one point of the distant *Object*, do meet be-
fore they come to the *Retina*, and afterwards
spreading themselves, fall only upon a little part
of the bottom of the *Eye*. And therefore those
who have such prominent *Eyes*, do approach the
Object to their *Organ*, to advance the too short
points of the visive *Cones* to the *Retina*. For the
nearer a thing is approached to the *Eye*, so much
the more are the *Rays* thereof turn'd aside, and
constitute shorter *Visive Pyramids* or *Cones*. But
Old Men remove the *Object* farther from their *Eye*,
that by making the points of the *Cones* longer, they
may reach the *Retina*.

VIII. *Convex Spectacles are of most use to Old Men, as Concave Spectacles to Squint-Ey'd persons.*
Hence it appears, that *Convex Spectacles* are
most useful for Old Men; as on the contrary, *Con-*
cave Spectacles are most helpful to such as are
Squint Ey'd. For seeing that the former stand in
need of having the *Rays* contracted, to the end
that the points of the *Cones* may be brought to
the *Retina*, this is effected by a *Convex Spectacle*:
but whereas the latter stand in need of a greater
dilatation of the *Rays*, thereby to advance the
Cusps of the *Cones* towards the *Retina*, this is ef-
fected by a *Concave Spectacle*. For by the in-
terposing of a *Convex Glass*, the *Rays* which be-
fore went to the *Rainbow*, and further, are by
this means gathered into the *Apple of the Eye*, so
that *Rays* are now received by the *Eye* from those
parts that were hid before, and those which before
were joined together, by the interposition of them,
are made distant from each other, and consequent-
ly represent the whole *Object* bigger than indeed it
is. But by the interposing of a *Concave Glass*,
many *Rays*, which before entred the *Apple*, are
thrust outwards to the *Rainbow*, or more outward
parts; so that those parts which were separate be-
fore, do now unite, and by means of this contra-
ction represent the whole *Object* less than it is.

IX. *How the Object forms its Image in the Eye.*
As to the second, viz. the forming of the *Image*
of the *Object* in the *Organ*, it will not at all be
difficult to conceive how this is done, supposing
we do well apprehend that the *Object* acts only
upon one point of the bottom of the *Eye*, viz. up-
on that which is directly opposite to it; and so
likewise that one only point of the *Retina*, viz.
the middlemost is affected by that one point of the
Object. For the *Rays* that proceed from External
Objects, at the bottom of the *Eye*, act upon some
Latitude of the *Optick Nerve*, which as to the

Figure doth as much resemble it, as the *Linea-*
ments of an Excellent *Painter*, drawn in a *Picture*,
can be like him. Besides, there is another reason
for this latitude of the *Retina* being like the *Object*,
viz. because it receives so many impressions in all
its parts, as there are different *Colours* or different
degrees of *Light*, in all the parts of the *Object*.
And because the name of an *Image* or *Likeness*
is attributed to that thing, which hath some
resemblance with the thing it expresseth;
therefore we may well give this name to the
Latitude of the *Retina*, on which all the *Rays*
proceeding from the *Object* do fall; and conse-
quently may affirm, that the *Object* doth pour-
tray its similitude or *Image* in the bottom of the
Eye.

Neither are we to look for any more perfect
likeness between the *Object* we behold, and its
Image, than there is between the *Objects* and *Ima-*
ges, that appear in a darkned Room, where only
one little hole is left for the *Rays* of *Light* to
enter, which are received at a convenient distance
upon *white Paper* or a *Sheet*. For tho' in this
case the *Images* of the *Objects* be very exactly de-
lineated, and their *Qualities* sufficiently exprest,
yet they appear invert, so that the right parts of
the *Object* are left in the *Image*, and those which
were uppermost in the *Object*, are neathermost in
the *Image*. As appears in the *Figure* before re-
presented, where we find Y, which is on the left
side, represents X, which is at the Right; and V,
which is at the Right, T, which is at the Left.
But how this comes about shall be shewed in the
next Chapter.

As to the Third thing to be resolved how the
Resemblances of *Bodies* are conveyed from the *Eye*
to the *Brain*, this also will be easily apprehended, if
we consider that these *Representations* pourtrayed in
the *Eye*, and admitted to the place of the Extre-
mities of the *Capillaments*, which compose the
Optick Nerves are so impress, as that the *Rays*
touch those *Capillaments*, not according to their
whole length, but only with their extremities.
And because this impression which is made at the
end of every *Capillament*, reacheth to the other,
it cannot be otherwise, but that the whole *Image*
of the *Object* must be conveyed to that place,
where these *Capillaments* are terminated, that is,
within the substance of the *Brain*. The *Rays*
therefore that flow from the *Body* X, to the *Eye*,
touch the end of some of the *Capillaments* of the
Retina or the *Optick Nerve*, at the point Y, and
those that come from the *Body* R, do in the point
S, touch the Extremity of some other *Capillament*;
and those that proceed from the *Body* T, the end
of another V, and so on. And since *Light* is no-
thing else but *Motion*, or a *propension to Motion*,
it is evident that all the *Rays* that are come from
XRT, being of force enough to move the *Ca-*
pillaments YSV, are consequently of force en-
ough to move the *Brain*. By which means an
Image is again formed in the inward surface of
the *Brain*, which faceth the Cavities thereof: For
by the word *Image* nothing else is understood
here, than the various *Motions* of the Parts of
the *Brain*, and so likewise those represented in a
Looking Glass, at the Bottom of the *Eye*, &c. are
nothing else but such kind of motions.

But

X.
This Image
is not in all
things like
unto the
Object.

XI.
How the
Images of
the Objects
arrive at
the Brain.

XII.
How it
comes to
pass that
only one
Sensation
is percei-
ved in the
Brain.

XIII.
Answer.

But it may be you will enquire, how it comes to pass that the *Images* proceeding from *External things*, and entering the *Brain*, do not exhibit these two, but one only *Object*, when yet there be 2 *Optick Nerves* which equally convey the *motion* impress upon them?

To this I answer, that there is a certain *Kernel*, in the midst of the *Ventricles* of the *Brain*, called *Comarion*, in which the 2 *Images*, proceeding from both the *Eyes*, are united, by means of those *Spirits* that fill the Cavities of the *Brain*. And this *Kernel* is called the Residence of the *Common Sense*, because the *Soul* immediately exerciseth its operations in it. When therefore at any time we behold an *Object*, by Example a *Flower*, the *Light* that is reflected from it, doth delineate 2 *Pictures* or *Resemblances* in each of our *Eyes*, and these draw 2 others, by the help of the *Optick Nerves*, in the inward surface of the *Brain*; which Representations being conveyed to this *Kernel*, do meet there, and are united; which *Kernel* consequently acting upon the *Soul*, represents to it the *Image* of that *Flower*.

XIV.
Why we
asert this
Kernel to
be in the
Midst of the
Brain.

Neither do we without good ground asert this *Kernel* to be in the midst of the *Brain*, as being the *Principal Seat* of the *Soul*, where all *Sensations* are performed. For we find that all the other parts of the *Brain* are double; as we have 2 *Eyes* to see with, 2 *Ears* to hear, and 2 *Hands* to handle, and the same may be said of the rest of the *Organs* of our *Senses*; and yet we see but one *Object*, and hear but one *Sound*, &c. wherefore it is necessary that both these *Images*, or rather *Motions* proceeding from 2 *Organs*, should meet together in one place, before they be considered of by the *Soul*. Neither is any such single part to be found in all the *Brain*, besides this *Kernel*, which is placed in the very midst of the *Ventricles* of the *Brain*, and consequently is surrounded by the *Spirits*, and therefore may well be accounted the seat of *Common Sense*, that is, of *Cogitation*, and therefore also of the *Soul* it self.

CHAP. XIX.

How Vision, or the Sense of Seeing is performed.

I.
The Soul
feels or is
sensible by
means of
the motion
of the
Nerves.

HAVING thus explained how the *Light* is transmitted through the *Humours* of the *Eye*; how *Objects* communicate their *Images* to the *Organ*, and how the said *Images* enter the *Brain*; it remains now that we explain, how this *Image*, communicated to the *Brain*, doth produce that *Sensation* in us, whereby we are said to *See*; and in the next place what are the Causes of the *Clarity* and distinction of our *Sight*; and Lastly, how the *Qualities* of *Objects*, viz. their *Situation*, *Distance*, *Magnitude*, *Figure*, *Motion* or *Rest*, are thereby discerned. Now that we may the better understand how this *Spiritual Image* is delineated in us, we are to call to mind, what hath been before handled *Chap. X. §. 6.* viz. that such is the Nature of our *Soul*, that by the force of those *Motions*, which are impress on that part of the *Brain*, whence the thin *Capillaments*, or *Hair-like Strings* of the *Retina* derive their Original, various *Sensations* are excited; so that the whole difference of them depends on the various *motion*,

which every part of the *Object* doth excite. Thus the *Soul*, by occasion of some *motions* that are made in the *Nerves* which belong to the *Ears*, perceives *Sounds*; and by means of the *motion* of those *Nerves*, that assist the *Organ* of *Tasting*, and act immediately upon our *Soul*, the *Sense* of *Taste* is stirr'd up in us, and so of the rest.

For these Impressions are nothing else, but various *motions* of the parts of the *Brain*, and of the *Animal Spirits*, affecting the *Glandula Pinealis* or *Pine-Apple-like Kernel*; to which when the *Soul* of *Man* attends, he discerns visible *Objects*, tho' these *motions* are not like the *Objects* which they represent. Just after the same manner as one that walks in the *Dark*, or is blind, distinguisheth *Objects* by means of a *Stick*, tho' neither the *Stick*, nor its *Motion* bear the *Image* of them. Or as *Words written* or *spoken*, serve to convey the knowledge of things to us, tho' they be no resemblances of the *things* they bring to our *Minds*.

It is manifest therefore, that the sight of any thing will be more clear and lively, according as there are more *Rays* proceeding from the *Object*, and entering the *Eye*: For by this means the impression made upon the *Capillaments* of the *Optick Nerve* is the stronger. The largeness of the *Apple* of the *Eye*, conduceth also to this purpose, by giving way to many *Rays*, proceeding from the same point of the *Object*, to enter the *Eye*, in order to the representing of its *Image* in the bottom thereof. Hence it is that we dilate and open the *Apple* of our *Eye* more in viewing a distant *Object*, than one that is near us; because then more *Rays* enter the *Eye* from the several points of it, than when we do straiten it and make it less. And for this reason it is that remote *Objects*, appear more clearly to us, than such as are very near to us, and the *Colours* of those appear more lively, but of these more dull and weak.

As to the *Distinction* of *Sight*, whereby the parts of the *Object* are discerned in their proper *Place*, *Situation*, *Figure* and *Colour*, it is certain that the same proceeds from the *Refraction* of *Rays*. Now to the end that the *Sight* of any *Object* may be very distinct, and admit of no confusion at all, it is necessary that all the *Rays*, which from the same point of the *Object*, are directed to the same point of the *Horny Membran*, be so refracted, as that they may at last meet and be united in the point of the bottom of the *Eye*. But seeing that this doth not happen, save only in those *Rays*, which proceed from that point of the *Object*, in which the *Axis* of *Vision* is terminated, it so happens that at that time, we can only have a distinct *Sensation* of that part, and of the rest a confused and indistinct view.

The other cause of *Distinct Vision*, depends on the *Capillaments* of the *Optick Nerve*; for seeing that we cannot discern the parts of *Bodies* we do behold, but only inasmuch as they are distinguish'd by *Colour*, and that the distinct perception of these *Bodies*, doth not only depend upon this, that all the *Rays* which proceed from the several points of *Bodies*, do in the bottom of the *Eye* meet in about so many other points; but is also caused by the multitude of the *Filaments* of the *Optick Nerve*, the *Extremities* or *Ends* whereof are contained in that space, which the *Image* at the bottom of the *Eye*

II.
What the
Images of
Objects are.

III.
How it
comes to
pass that
some Objects
appear
more clear-
ly than
others.

IV.
What is
the Cause
of the Di-
stinction of
Vision.

V.
The other
Cause of
Distinct
Seeing.

Eye doth take up; it follows that there must be so many ends of these *Capillaments*, as there are sensible parts in the *Object*, that reflect their *Rays*. For if the *Rays* proceeding from 2 different parts of the *Object*, should meet in 2 divers points of the same *Filament* separately, it would be the same as if they met in the same *Point*, because they could not move that one *Filament* after 2 several manners. Whence it is that *Fields*, in the *Summer-time*, abounding with *Red* or *Yellow Flowers* that grow amongst the *Grass*, do seem to be wholly *Red* or *Yellow*; because both the *Grass* and *Flowers* acting together upon one and the same *Capillament*, the *Flowers* which are of a more lively *Colour*, do only appear to the *Eye*, because that *Filament*, at that time only follows the motion, which the *Flowers* impress upon it.

VI. *How the Situation of the Object comes to be discerned.*
The situation of *Bodies* is not perceived by any Representation or other Action, proceeding from them, but only by the Impulse, coming from a certain Region or quarter, to some particular part of the *Brain*. For the *Object* seems to be situate in that part, from whence the *Rays* come that affect the *Eye*. Thus we suppose the *Candle A C*, to be placed in such a quarter, because the *Eye B D E*, doth from thence receive the *Rays* that make an Impression upon it, which Impression gives occasion to the *Soul* to judge that the *Candle A C*, takes up such a situation amongst other *Bodies*. For the knowledge of the situation of any thing depends only on the situation of the particles of the *Brain*, from whence the *Filaments* of the *Nerves* do arise: But forasmuch as those *Filaments* are diversly affected by *Bodies* in different places, because of their various disposition, the *Soul* by their peculiar motion, discerns their different situations. Thus when we turn our *Head* or *Eye* this way or that way, the *Soul* is put in mind of that thing, by the Change which the *Nerves* inserted in the *Muscles* subservient to that Motion, do effect in our *Brain*. For when the *Eye B D E* sees the *Candle A C*, the *Soul* may know the situation of the said *Candle*, because the *Nerves* of the *Eye* partake of another disposition, than if it lookt another way.

VII. *Why the Image of an Object is turn'd upside down in the Eye.*
Nevertheless it is to be observed, that tho' *Objects* be perceived in their natural situation; yet their *Images* are turned upside down in the *Eye*. The reason whereof is, because but one of those *Rays* that enter the *Eye* being *Perpendicular*, and *Direct*, and the rest, because of the straitness of the *Aperture* of the *Eye* entering obliquely, it happens that the *Oblique Ray A B*, proceeding from the upper part of the *Candle*, and the *Ray, C D*, flowing from its lower, do intercept one another, so that the lower part *C*, of the *Candle*, is represented at the bottom of the *Eye* upwards about *D*, and the upper part *A*, of the *Candle* appears about *B*, by which means the *Candle* is delineated in the *Eye* inverted. This any one can make an Experiment of, by taking the *Eye* of an *Animal*, devided of all its *Membrans* and *Muscles* besides the *Retina*; for supposing that this *Eye* be placed before the little hole of a *Darkened Room*, and the *Candle A C*, be set opposit to it, if then standing in the *Room* we look into the bottom of the *Eye*, we shall see the *Image* turn'd upside down.

VIII. *Things at a great di-*
This inversion of the *Image* in the *Eye*, is the cause why things appear by so much higher as

they are farther from us; because *Rays* that proceed from things near to us, do reach the upper parts of the *Eye* or *Retina*; whereas those that flow from *Objects* far distant, do come to the lower part of the *Eye*: And consequently it is necessary, that the former should appear Higher, and these latter Lower.

The Distance of *Objects* is discerned by the various motions that change the *Figure* of the *Eye*: For when we behold things at a Distance, the *Aperture of the Eye* becomes more dilated, and the *Crystalline Humour* is somewhat withdrawn towards the *Retina*, and by this means the *Figure* of the *Eye* becomes more Round: whereas, when we view *Objects* that are near to us, the opening of the *Aperture of the Eye* is lessened, and the *Crystalline Humour* contracted, and thrust outwards; by which means the *Eye* becomes more extended in length. And whilst we thus change the *Figure* of our *Eye*, according to the various situation of the *Object*, an alteration consequently happens in the parts of the *Brain*, Nature having so ordered it, that the *Soul* thereby might be informed of the distance of the *Object*.

The Distance also of *Objects* may be discerned by the distinct or confused Representation of them, and so likewise by the strength or weakness of the *Light*. Thus when we know the Bulk of a *Body* beforehand, its distinct *Figure*, and the Liveliness of its *Colour*, this knowledge will help us to know the distance of it. The Interposition also of many *Bodies* between us, and those *Bodies* which we behold, conduceth not a little to the perceiving of their Distance; because the distance we imagine there is between them, serves us for a measure whereby to take the distance of the *Objects* we are viewing. Thus when the *Moon* is very high raised above the surface of the *Earth*, it seems nearer to us when no visible *Bodies* interpose between us and it, than when many *Terrestrial Bodies* intervene: The strength also and weakness of the *Light* are of use to inform us of the Distance of *Objects*: For *Bodies* illustrated with a weak *Light*, are apprehended to be at a greater distance, and those things to be nearer to us which are seen distinctly, and under a strong and vigorous collustration. And therefore it is that towards *Night*, or in misty Weather, things that are near appear as if they were at a distance from us.

By perceiving the Situation and Distance of every *Object*, we are informed of the Bulk and Bigness of it: Thus when the *Rays* from *A* and *C*, are decussated, or intersect one another at the *Aperture of the Eye E*, the *Objects Angle of Vision* being known, the *Soul* by this Impression, being informed of the length of these *Rays*, easily discerns the Quantity of the line *A C*, which is the Magnitude of the thing. So that if ever the *Mind* mistake in judging of the Bulk of any thing, it is only because it hath not rightly perceived the distance of it. As it happens to a person, who not being able to conceive the great distance there is between the *Sun* and the *Earth*, will never know the true Magnitude of the *Sun*. And this is the Reason why the *Sun* and *Moon*, when they are nearest to the *Horizon*, appear bigger than when they are farther from it; which doth not happen because they sometime appear under a greater, and at other time under a less Angle, but because they are judged to

Distance appear higher

IX. *How the Distance of things is perceived*

X. *Other ways of discerning the Distance of Objects.*

XI. *How the Bulk of the Object is perceived.*

H h h h

be

be at a greater distance. For our *Modern Astronomers*, who have measur'd the *Angle* under which the *Sun* or *Moon* appear at their *Rising* and *Setting*, find it to be the same with that under which it appears about the *Meridian*.

XII.
How the
Figure of
Object is
perceived.

We judge of the *figure* of any *Object*, from the knowledge or opinion we have of the *situation* of the different Parts of it, and not at all from the likeness of the *Images*, that are delineated in the *Eye*; forasmuch as those *Images* are often *Elliptical*, and of an *oblong Square*, which represent to us *Objects* that are perfectly *Round* and *Equilateral Squares*. Thus *Square Objects*, that are at a great distance from us appear *Round*, because the great distance of the *Angles* obliterates the *Settings-out* and *Unevenness* of the *Object*. In like manner, *Round* or *Concave Bodies* appear with flat and even *Surfaces*, because the *rising* or *depression* of any of the Parts, by reason of the great distance, escapes the *Eye*. Thus he who beholds the *Sun*, doth not discern it to be round, but flat, tho' indeed the middle parts thereof be nearer to our *Eyes*, than those that are towards the *Edges*: but so vast is the distance between the *Sun* and our *Eye*, that the foresaid proximity of the middle Parts, is not at all considerable or perceptible.

XIII.
How the
Motion or
Rest of
Bodies is
perceived.

Lastly, *Motion* is perceived when the *Images* of *Objects* impress on the *Eye*, do run through several Spaces in the *Retina*, and successively answer to other *Images* of *Objects*, which we look upon as immovable. Or when the *Eye* is fain to turn it self, that it may continue to have the *Sight* of the *Object*. So likewise the *Rest* of Visible things is perceived, when the *Eye* continuing without *Motion*, the *Images* represented in the *Retina* are at *Rest*, and continue to have the same *Respect* to another *Object*, which is consider'd as without *motion*.

XIV.
There must
be a due
Distance
between
the Object
and the
Eye.

Figure
73.

Moreover it is to be observed, that in order to the due and right *seeing* of any *Object*, there is required a due distance, to the end that the many *Rays* that proceed from the several Points of the *Object*, may meet together in every least part of the *Retina*. As likewise, that the *Image* of the *Object*, may be represented in the bottom of the *Eye* sufficiently great and perceptible. Otherwise if the *Object*, for Example D, be too near, the *Rays* that proceed from it, as A B C, will enter so obliquely into the *Convex Surface* of the *Eye* A C, that the *Retina* E cannot be affected by them, as not being sufficiently gathered together. Wherefore since the meeting of the *Rays* is only in F, it is no wonder if no perceptible *Image* of the *Object* be delineated in the bottom of the *Eye*. Forasmuch as the *Action* of *Seeing* cannot be performed, except the *Rays* entering the *Apple* of the *Eye*, and being refracted at their meeting with the *Membrans* and *Humours*, strike upon the *Retina*, and impress the *Image* of the *Object* upon it.

XV.
The too
great dis-
tance of
the Object
produces
only an
obscure
Vision.

But when the *Object* is at too great a distance, the contrary happens; for seeing that then only a few *Rays* proceed from every Point of the *Object*, and that those that come from them, do too much approach to a *Parallelism*, it so happens that they are united before they reach the *Retina*; and presently after separating themselves again from that Point of their meeting, cannot sufficiently move

or agitate the *Retina*; whereupon only an obscure *Image* of the *Object* is represented. By Example, If the *Object* A be supposed to be far distant from the *Organ*, it is evident that only a few *Rays* will flow from each Point of it; and that the *Rays* A B, A C, A D, proceeding from each Point of it, by their inclining too much to a *Parallelism*, will unite about E, before they come to the *Retina* F. Whence it will follow, that either a too little *Image* of the *Object* will be drawn at the bottom of the *Eye*, or none at all.

Figure
74

To prevent this defect, a *Telescope* or *Prospective Glass* is employ'd (that is, an Instrument whereby the *Visive Faculty* is assisted to discern *Objects*, that are at a great distance distinctly) which consists of 2 *Glasses*, viz. a *Convex* and a *Concave*: For by the first of these the *Rays* are so gather'd, that before the union or coition of *Cones* like to those which are produced by the *Eye*, the *Concave* intervenes, which by somewhat dilating of these *Cones*, doth advance their *Points* or *Cusps*, and renders them more distinct; so that being received into the *Apple* of the *Eye* after *decussation*, they again meet in the *Retina*, and according to the proportion of the *Convexity*, represent the thing greater. Wherefore, if such an *Instrument* be duly applied to the *Eye*, it makes the *Rays* that are gather'd about E, and afterwards scatter'd again in the *Retina* F, become gather'd in it, by means of the *convexity* of the *Eye*, and so produce a distinct and exact *Vision* or *Sight*. For the *Telescope*, by reason of its great *Pupil*, makes the *Object* to be seen by many *Rays*, and because of the *Convex* figure of the outward *Glass*, which congregates the *Rays*, it appears under a greater *Angle* of *Vision*. This *Instrument* causeth also a great *decussation* of the *Rays*, which enter the Round outward Extremity of the *Tube*, towards the *Retina*; and by this means a great Representation or *Image* of the *Object*, is delineated in the *Eye*, so that things at a distance appear great and distinct.

XVI.
What a
Telescope
or Prospe-
ctive-Glass
is, and how
Objects at
a distance
are percei-
ved by it.

How liable we are to be deceived by our *Sight*, as well as by our other *Senses*, will be evident to us by considering the manner how all our *Sensations* are formed, and more particularly that of *Seeing*. For hence it is, that some *Objects* appear more clearly to us than others; and that their *Place*, *Situation*, *Figure*, and *Colours*, are not always distinctly represented; that their *Bulk* seems sometimes greater, and at other times less; yea, and sometimes they are altogether *invisible*, especially those Parts that make their *Essential constitution*. In the *Bud* of a *Tulip-Root*, with a *Microscope*, we may easily discover the *Leaves*, which afterwards turn *Green*, those which are to compose the *Flower* it self, and that little Triangular part which contains the *Seed*, with the 6 little *Pillars* that surround it, at the bottom of the *Tulip*. And the same may be said of the *Bud* of a *Mustard-Seed*, of the *Kernel* of an *Apple*, and generally of all sorts of *Trees* and *Plants*: For tho' nothing of all this can be perceived by the *Eyes*, no not when assisted by a *Microscope*; yet we may with confidence conclude that they are all contain'd in the *Bud* of their *Seeds*. This may also appear in little *Animals*, as in the *Mites* that breed in rotten *Cheese*, and those little *Worms* that gnaw the *Skin*, and cause the

XVII.
Of the
Deception
of the
Sight.

the *bands to itch*, which have all of them *Organical Bodies*, as well as any other *Animals*. And as we see in the *Bud* of a *Root* of the *Tulip*, the whole *Flower*, so likewise we may perceive in the *Treadle* of an *Egg*, which the *Hen* hath not yet fit upon, a *Pullet*, which it may be is wholly formed. So likewise *Frogs* may be perceiv'd in the *Spawn* of *Frogs*. To which add what *Malbranche* asserts, that probably there are infinite *Trees* in one only *Bud*, and that all the *Plants*, and all the *Bodies* of *Man* and *Animals* that shall ever be, have been produc'd from the beginning of the *World*. Now it is certain, that all these things cannot be perceived by our unassisted *Eyes*; yea, and that the greatest part of them cannot be perceived with the help of the most excellent *Microscopes*: And much less by our other *Senses*, which the *Sight* excels in *order*, *dignity* and *extent*. Neither must this seem any whit strange unto us, forasmuch as it is only the *Surface* of *Bodies* that affects our *Senses*, and that it is not their whole *Surface* neither that is capable of affecting our *Senses*, but those *Parts* only of it that are big enough to move the *Fibres* of the *Nerves*. And forasmuch as those *Parts* which make up the *Essential* Constitution of the *Body*, are very often too small to move the *Fibres* of the *Nerves*, that belong to the *Organs* of *Sensation*; it must follow that they are hid from us, and that the *Object* which we perceive, may be quite different from what it appears to be.

CHAP. XX.

Of Waking, Sleep, and Dreams.

NEXT after the *Senses*, it seems proper to treat of *Waking* and *Sleep*, forasmuch as by these their *Operations* and *Cessations* are determin'd. For *Waking* is the free *Exercise* of the *Senses*, depending on the uninterrupted influence of the *Spirits* into the *Organs*. And therefore those things which increase the *Animal Spirits*, or do more strongly agitate them, are the Cause of *Waking* or *Watchfulness*. *Sleep* is a *Binding* of the *Senses*, proceeding from the want of *Spirits*. Wherefore those things which diminish the *Spirits*, or foreflow their *motion*, provoke *Sleep*. So that *Waking* and *Sleeping* differ no otherwile, than as *Loosing* and *Binding*, or as the *Flowing* or *Standing* still of the *Water* that is in a *River*. For if we give heed to our own Experience, we know nothing else of *Waking*, save that it is such a state, wherein we hear the *Voices* of those that *speak* to us, see visible *Objects*, are moved by the things that *touch* us, and are sensible otherways of those thing whereof our *Nature* is capable. And as to *Sleep*, we experience it to be a state opposite to this, and wherein we are not excited by the *Objects* wont to strike our *Senses*, but our *Body* rests as depriv'd of all *motion*.

To the end therefore, that we may be able to give an account of both these *States*, we are to observe, that the *state* of *Waking* consists in this, That the *Animal Spirits* (which as was said before, are the most lively parts of the *Blood*) being in great abundance in the *Brain*, are easily determin'd by the *Glandula Pinealis*, to flow into the *Nerves*, and fill them so, that all their *Capilla-*

ments are kept stretched or distended, and separate from one another. For supposing this affluence of the *Spirits* in the *Brain*, if any *Object* acts upon our *Body*, it may be easily conceived, that the *Capillaments* of the *Nerves*, that terminate towards that *Part*, will convey the *motion* they have received, to that very part of the *Brain*, which immediately stirs up the *Soul* to *Sensation*. For it cannot be difficult for us to imagine, that the *Animal Spirits*, which are then determin'd towards certain *Muscles*, cause those *Parts* of the *Body*, in which the *Muscles* are inserted to be moved. So that *Waking* or *Watchfulness* is nothing else, but the *Dilatation* of the *Animal Spirits* in the *Brain*, and throughout all the *Nerves*, whereby the *Organs* of the *Senses* are at full liberty to transmit the *motions* of the *Objects* to the *Common Sense*, placed in the midst of the *Brain*.

Watching may be effected by many Causes. First, By those things which thin the *Blood*, or which over-heat it, and by agitating it too much, increase the *Animal Spirits*. Secondly, By things which open the *Plexus Choroideus* of the *Arteries*, and so make way for the *Spirits* to enter into the *Nerves*. Thirdly, By things that stir and agitate the *Body* over-much, and by making the *motion* of the *Blood* more swift, occasion a greater *Briskness* and *Liveliness* in the *Body*. Fourthly, By Moderate *Sleep* or *Rest*, which recruit the *strength* of the *Body*, and make it with more agility and chearfulness to perform its *Task*.

Sleep being the State that is opposite to *Watching*, and wherein the outward *Senses* are bound up, and cease from their *Functions*, we shall easily understand how it is effected, by assigning a different disposition to the *Brain*, from that which *Watching* doth produce. Forasmuch therefore as the State of *Waking* doth consist in the great abundance of the *Animal Spirits*, which replenish the *Ventricles* of the *Brain*, and the *Pores* of the *Nerves*: *Sleep* on the contrary must consist in a deficiency and want of the said *Spirits*, which causeth the *Pores*, through which the *Animal Spirits* are wont to flow into the *Nerves*, to grow limber and cling together, and being no longer distended by the copious afflux of the *Spirits*, to be shut up. For where this Obstruction happens, the *Animal Spirits*, which before were contained in the *Nerves*, are dissipated; and there being no other in a readiness to supply their places, the *Filaments* of the *Nerves* cling together: So that if in this State an *Object* should act upon any part of our *Body*, yet can it not transmit that Impression to the *Brain*, and consequently no *Sensation* can result from thence. Besides, the *Muscles* being then empty and void of *Spirits*, become limber and flagging, and so cannot be of any use for the *motion* of the *Members* to which they belong, nor keep the *Body* in an upright posture, any more than if they were quite vanish'd. And accordingly in *Sleep*, the *Body* lies along, the *Eyebrows* fall, the *Head* nods, the *Knees* fail, and all the *Senses* cease from their *Actions*. And therefore *Sleep* is nothing else, but a relaxation of the *Ventricles* of the *Brain*, and a flagging of the *Nerves*, proceeding from the want of *Animal Spirits*, whereby the *Organs* of *Sense* are at a stand, and unfit to convey the *motions* of the *Objects*.

III.
The Causes
of Waking
or Watch-
ing.

IV.
Wherein
the State
of Sleep
consists.

I.
How Sleep
is distin-
guish'd
from Watch-
ing.

II.
Wherein
the State
of Waking
or Watch-
fulness
consists.

V.
The Opini-
on of the
Peripate-
ticks con-
cerning
Sleep.

VI.
This Opini-
on rejected
by those that
hold the
Circulation
of the
Blood.

VII.
The true
Cause of
Sleep.

VIII.
During
Sleep, our
Blood is
hotter than
when we
are awake.

Objects to the Brain, and to the Common Sense.

But whence this Effect doth proceed, and what that Band is, whereby the Actions, as well of the Inward as Outward Senses, are suppressed and bound up, is not so easie to determine. 'Tis a common Opinion amongst Philosophers, especially those that follow Aristotle, That Sleep is caused by the Vapours proceeding from the Chyle and other Humours working in the Stomach; which being afterwards condensed, cloud the Brain, and cause Drowziness and Dulness.

But this Opinion is not approv'd of by them, who hold the Circulation of Blood. For these cannot discover, by what ways these Vapours elevated from the Stomach, should through so many of the Inward parts and Bony prisons, as through so many Obstacles, be carried up to the Brain; forasmuch as their Opinion is, that the most part of those Humours that moisten the Brain, is transmitted through the Arteries, and immediately communicated to it from the Mass of Blood. Besides, if Sleep be owing to the Vapours that arise from the Stomach, why is it not always consequent to the taking in of Food; and why is not Watching always the Effect of our abstaining from Meat? When yet we frequently experience the contrary, that many times with an Empty Stomach we fall into a Deep Sleep; and when we have eaten freely are inclin'd to be watchful. Moreover, Children are apt to fall asleep, by Warmth, Singing, Darkness, and the Rocking in a Cradle; and yet none of these contain any thing of these Vapours, that are suppos'd so necessary for the causing of Sleep. To which may be added, that if a Ligature be put upon the Inward Jugular Arteries or Veins of any person, he will presently fall asleep; which is the Reason that those who are hanged, seem to themselves, as it were, to fall asleep, as soon as they are turn'd off.

Wherefore the Cause of Sleep is not to be attributed, to the Fumes and Vapours that arise from the Stomach; but rather to the deficiency of the Animal Spirits, or the diminution of their motion. For Opium, Poppy, Mandrakes, and other such like Sleep-provoking Medicaments, do not produce their Effects by raising copious Exhalations from the Chyle to the Brain; but because they hinder the motion of the Spirits that way, and by their Fuliginous Humour stop the Spirits that are contained in the Brain, from being conveyed to the outward Membrans. And accordingly gross Meats, and hard of Digestion, which oppress the Stomach, commonly cause Sleep and Drowziness; because they do fix and dull the Spirits contained in the Stomach, and by the consent and correspondence there is between that part and the Brain, make the Spirits there more dull and heavy.

But yet forasmuch as the Spirits can never be without a considerable degree of Agitation, and can never be so far dull'd, as to be destitute of all motion; it must follow that not being now employ'd to keep the Body awake, they must needs increase the motion of the Blood wherewith they are mingled; and therefore we find, that the Body is much hotter whilst asleep, than when awake: For we find, that in the Coldest Weather in the Winter, our Bodies are very hot when asleep, but are no

sooner awake, but we need Fire, or some strong and violent Exercise to preserve us from being sensible of extream Cold, and the rigour of the Weather.

Sleep is discult either by force, or of it self: The former way is, when the Organ of any of the Senses is so struck, that the impress motion arrives at the Brain; because by this means the Spirits that are in the Brain may be so agitated, that joyning themselves with others that are carried that way, they may produce Waking. And Sleep ends of it self, when the Animal Spirits, which the Blood doth produce whilst we are asleep, are in such abundance conveyed to the Brain, that opening the Passages of the Nerves, and rushing into them, they distend the Filaments thereof, and by this means give the Soul occasion to perceive the several Objects that touch and affect the Body.

The Imaginations of those who are asleep, are called Dreams, when the Soul, while the Body is asleep, apprehends things, and discourseth of them, as if it were awake. Now this happens, when during Sleep the Animal Spirits enter these Foot-steps, that were before impress on the Brain, moving some Parts thereof in the same manner, as they are wont to be moved by the presence of an Object, acting upon the Organ of the Senses.

For notwithstanding that in Sleep, the greatest part of the Pores or Passages of the Brain, are stop'd up by a thick Vapour, or rather Humour; and that the Fibres, by reason of this Obstruction, become less active, especially those by which the affection, or impress motion, is conveyed from the outward Sense to the inward, and from the Plexus Chorooides, to the bottom of the Brain, and Original of the Nerves; yet the rest may notwithstanding this discharge their Function, at least in part; which is the Cause why Imaginations are easily excited in us whilst we are asleep, by the least motion or impression from the Blood, Gall, or Pilegm, or of those Vapours that are the Cause of the foresaid Obstructions, which make the Fibres so torpid and unactive. And this is the reason why things are but confusedly represented to us, whilst we are asleep.

The difference and great variety of Dreams, proceeds first from the variety of the Foot-steps of former motions impress upon the Brain. Thus we find frequently, that the things wherewith we have mostly entertained our Thoughts in the Day-time, are apt to be represented to us in Dreams by Night. Secondly, From the peculiar temperament and complexion of the Body, and the difference of Meat and Drink, whence the Spirits are generated. Thus Persons of a Cholerick Temperament dream of Quarrels, Fightings, Fires, &c. Pblegmatick Persons, of Water-floods, Drowning, &c. Thirdly, From Custom; which being a kind of second Nature, hath its effect upon us even during Sleep.

Forasmuch as the Parts of the Brain, which have been before moved by the outward Action of the Object, are more easily moved than those that have been in continual Rest: Therefore it commonly happens that the Animal Spirits push against them; so that we seldom dream of any other things, but such as we have perceived by some Sense

IX.
How Sleep
comes to
cease.

X.
What a
Dream is,
and what
the Cause
of it.

XI.
How
Dreams
are pro-
duc'd.

XII.
The Cause
of the
difference
of Dreams.

XIII.
Dreams
are form'd
from things
that are
seen.

Sense or other whilst we were *awake*. And accordingly we find but little difference, between the things we behold *waking*, and those which appear to us in *Dreams*; and that there is much the same succession of our *Imaginations* in our *Dreams*, as when we are *awake*, which tho' they seem sometimes incoherent, yet is there commonly some hidden connexion between them.

XIV.
How it comes to pass that our Dreams are sometimes strange and irregular.

But because the *Objects* that are represented to us whilst we are awake, are in great number, and may variously affect the same parts of the *Brain*, it would be strange, if in the interval that is between *Sleeping* and *Waking*, the *Spirits* that are continually ranging through the *Pores* of the *Brain* should not promiscuously move some of the parts of it, that is, partly as they were moved at the presence of one *Object*, and partly as they were at the presence of another: and by this means it may come to pass that the *Soul* may perceive a monstrous representation, as of a *Goat* with a *Lions Head*, or the like; so that we have no reason to look for any *Connexion* or *Order* in our *Dreams*.

CHAP. XXI.

Of the Appetite of Hunger and Thirst.

I.
Why Hunger and Thirst are called Natural Appetites or Desires.

Seeing that *Hunger* and *Thirst* are perceived after the same manner, as the other *Senses*, viz. by the *Ministry* of the *Nerves*, which like so many fine *Threads* proceed from the *Brain* to the *Stomach* and *Gullet*; it seems convenient that having spoken of the *Senses*, we should now proceed to explain what *Hunger* and *Thirst* is. Which 2 affections, are commonly called *Natural Appetites*, because they suppose a *Compound* of *Soul* and *Body*, and are generally accompanied with a desire to *Eat* and *Drink*.

II.
Aristotle's Opinion concerning Hunger and Thirst.

ARISTOTLE defines *Hunger* to be a desire of that which is hot and dry; but does not take notice whence this *Appetite* doth arise, nor how it comes to be stirred up; nor do I believe that any of his *Qualities* will be able to explicate the nature thereof. For we find that *Infants* and other new born *Animals* desire *Milk*; but who will say that the *Appetite* to *Milk* is only the desire of that which is dry? Or shall we say that *Animals* when they desire *Herbs* and *Fruits*, are carried out with an *Appetite* to that which is *Hot* and *Dry*, when a moisture can be separated from them, which far surpasseth their *dry substance* in quantity? Again, how can *Hunger* be said to be the *Appetite* of that which is hot and *Dry*, seeing that *Herbs* and *Fruits*, according to all that we can perceive by them, have more cold than heat in them?

III.
What Hunger is, and how it is caused.

Hunger therefore is nothing else but a *Sense* arising in the *Ventricle*, from an *Acid Juice* twitching the *Nerves* thereof. For as the various motions of the *Optick Nerve*, makes the *Soul* to perceive and discern all the varieties of *Light* and *Colours*; so there is nothing that can produce the sense of *Hunger*, but the motion of some *Nerves* inserted into the bottom of the *Stomach*. For the better understanding how this is done, we are to take notice that when the *Stomach* is empty of *Food*, the *Juice* or *Liquor* which is wont to flow out of the *Arteries* into the *Stomach*, and there to

minge with the *Food*, finding no matter to work upon, twitcheth the *Nerves* of the *Stomach*, which motion being conveyed to the *Brain*, stirs up the *Sense* of *Hunger*.

Some *Physicians* are of opinion, that this *Liquor* is conveyed into the *Stomach* by *Veins* from the *Spleen*: But that they are mistaken herein, is evident by this *Experiment*, that when a *Ligature* is made on the *Vas Breve*, the *Vessel* that lies between the *Spleen* and the *Stomach*, that part of it which is betwixt the *Ligature* and the *Stomach* swells, whereas the other part grows flag and empty; which is a plain evidence that some *liquor* is conveyed by the said *Vessel* from the *Stomach* to the *Spleen*, and not from the *Spleen* to the *Stomach*. Moreover, the *Valvula* that are in the *Vas Breve venosum*, do oppose the transmission of any *liquor* from the *Spleen* to the *Stomach*, because all of them lead towards the *Spleen*. Whence it is manifest that something is transmitted from the *Stomach* to the *Spleen*, but not the contrary way.

Now this *Liquor* which causeth the sense of *Hunger* is *sowre* and *sharp*, as being the off-spring of *Choler* and *Melancholy*, and which therefore lighting on the bottom of the *Stomach*, cannot but twitch and prick the *membrans* whereof it doth consist. Hence it is commonly observed, that *Melancholy Persons* are great *Eaters*, because this *Juice* is more *sowre* in them, than in others, by which means the *Food* is soon consumed thereby, as *Metals* are in *Aqua Fortis*, and other acid *Spirits*, and the *Guts* egg'd on to a ready *Evacuation*.

And on the contrary it sometimes happens, that persons who have not eaten of a good while, yet have no sense of *Hunger*, nor any desire to *Eat*, as it is frequently so with *Phlegmatick Persons*. Because this *Juice* by some obstruction or other is hindered from entering into the *Stomach*, or because it is too thin and weak, so that the *Stomach* is not sensible of the weak impression it makes upon it; or because its force is blunted by some cold and clammy *Humour*, or because there is but little of this *sharp Humour* conveyed to the *Stomach*. For it is always one or other of these causes that occasions the want of *Appetite* to *Food*, and more especially in *Sick People*.

And on the other hand there are some persons that are troubled with continual *Hunger*, and who like *Dogs* are ever *Ravenous*, and never satisfied; because so great quantity of this *sharp Humour* is conveyed to their *Stomachs*, that all their *Food* thereby is made *sowre*, so that their *Stomach* is continually twitched, and solicited to desire more *Food*, the former being readily evacuated downwards, or else cast up by *Vomit*. And thus it comes to pass, that some of this *Humour* is sometimes transmitted to the *Vena Laetea*, and continually besiegeth the *Stomach*.

But if this *sharp Humour*, lodging in the bottom of the *Stomach*, be of such a *Temperament*, as to have a peculiar force to dissolve some *Food* sooner than other, then it will be apt to stir up the *Appetite* of one sort of *Meat* rather than another. Hence some *Women* eat *Coals*, *Chalk*, *Quick-lime* and the like. Now the cause of this variety of this *sowre Humour* may be, because in the first Months of *Conception*, the Mouth of the *Womb*

IV.
No Liquor is conveyed out of the Spleen into the Stomach.

V.
The Nature of the Liquor that flows out of the Arteries.

VI.
Why some Persons are very seldom sensible of Hunger.

VII.
Of Persons that are troubled with a Dogs hunger, as 'tis called.

VIII.
The Irregular Appetite of Women with Child.

being stop'd, that the *Superfluous Blood* cannot be evacuated as formerly, by this means the *Humours* of the *Body* are corrupted, and being conveyed to the *Stomach*, produce an irregular *Appetite*. And therefore some *Physicians* are of opinion, that when the *Melancholy Humour* is deprav'd in *Women*, they long for *Quick-lime*, *Coals*, &c. when *fourre Phlegm* abounds in them they desire *sourre things*; and when *Gall* predominates, *Bacon*, *Suet* and such like. And it is from the same Cause that young *Girls* that are troubled with the *Green-Sickneß*, as we commonly call it, do take a liking to strange and unnatural sorts of *Food*, such as *Coals*, *Chalk*, *Leather*, &c. because their *Blood* for want of due evacuations grows sharper than ordinary, and consequently the *Humour*, which is derived out of the *Blood* into the *Stomach*, partaking of the same Quality, more violently twitches the *Nerves* thereof, and that after a peculiar manner, according to the various constitution of the *Blood* in every Individual.

IX.
It is not
Heat that
digests the
meat in our
Stomach.

This discovers to us the mistake of the *Peripateticks*, who suppose the *Stomach* to be like a *Kitchen*, where the *Food* is concocted and digested by heat only: whereas we find that there is but a moderate heat in the *Stomach*, and yet that even *Bones* are consumed and digested in it, as in the *Stomach* of a *Dog*, which if they should be boild for some Months together in a Pot with a very strong *Fire*, would never undergo any such change, as we find they do in the *Stomach*. Besides, *Historians*, and particularly *P. Bressano* in his *Relation of New France*, tell us of most ravenous and devouring *Fishes*, which do readily digest the hardest *Bodies* and turn them into *Liquor*, whose *Stomachs* notwithstanding are so cold, that one can scarcely endure to touch them; which is an incontestable Argument, that the dissolution of *Food* in the *Stomach* is not to be attributed to heat, but to the foresaid acid Juice in the *Stomach*, which dissolves our *Food*, as some acid Spirits do *Metals*.

X.
What Thirst
and what
Drink is.

Thirst is a Desire of Drink, caused by the dryness of the Throat and Gullet, or the Heat of the *Stomach*, commonly called Heart-burning, or a Salt Savour sticking to the Tongue. By the name of Drink we understand every sort of liquor, that is not Salt, Fat or too bitter, for Salt, Fat and Bitter Liquours do rather inflame the Thirst than allay it.

XI.
What is the
Cause of
Thirst.

To be informed of the Cause of Thirst, and that Driness which is sometimes in the Mouth, Tongue and Palate, we are to consider that the moisture which continually ascends from the *Stomach* to the Gullet, in the form of a thick and moist Vapor, for the moistning of those parts, when at any time it is over agitated or heated, it doth so dry the Swallow, and at the same time so affect the Nerves, as to excite in the Soul the Appetite of Thirst. So that there is a greater difference between the Vapor which provokes Thirst, and that Liquor which produceth Hunger, than there is between Sweat, and that which exhales from the whole Body by insensible Transpiration.

XII.
Thirst is not
an Appetite
of some-
thing that
is cold.

ARISTOTLE was of opinion that Natural Thirst was the Appetite or desire of something that is moist and cold. But this doth not seem probable; for tho' Thirst seem to be a desire of something that is moist, in order to dissolve, di-

lute and macerate the Food we have taken, and turn it into Juice; yet there is no need it should be cold rather than Hot; forasmuch as any moisture doth extinguish Fire be it hot or cold. But whether it be more conducing to health to use Cold or Hot Drink is not so easily determinable, because of the different Temperaments of Bodies. Only we find by Experience, that the drinking of some extreame cold liquor is very hurtful to the Body, whereas it is seldom known that any hurt accrues to us, by the using of hot drink.

Thirst is caused several ways, as either presently after we have eaten, because of the driness of our Food, which like a Spung, drinks up the moisture of our Stomach; or when our Throat is heated by the effusion of Gall, eating of high seasoned Meats, &c. or from some Salt Humour conveyed to that part, whence not only the imagination of drinking is awakened, but also an inordinate desire thereof, by which means some persons long for Vinegar, Urin, Stinking Water, &c.

XIII.
Of the Dif-
ferent
Causes of
Thirst.

CHAP. XXII.

Of the Common Sense, Imagination, and Memory.

THE Common Sense, Imagination and Memory, are called the Inferiour Faculties of the Soul, as being attributed to it, because of its intimate union with the Body; whereas the Understanding and Will are stiled its Superiour Faculties, because they appertain to the Soul, simply considered, and without any respect had to its Relation with the Body. But as these latter are not Beings distinct from the Soul it self, but only Modes of it: So neither are the former any thing else but different modifications thereof, arising from its intimate union with the Body. Thus the Soul, forasmuch as it perceives all the motions imparted to the Brain from the outward Organs of the Senses, is called the Common Sense; with respect to its long retaining and preserving the same perceptions, it is called Memory; and forasmuch as it variously compounds and divides the same, it is called Imagination. In like manner, with respect to its desiring or having an aversion by reason of the Objects that are represented by those perceptions, it is called the Sensitive Appetite; as the Locomotive or moving Faculty is attributed to it forasmuch as it commands the Animal Spirits, and by their means variously moves the Members of the Body according to its pleasure. So that these Faculties are indeed nothing else, but outward modifications, or ways of our considering the Soul, which makes it no more to differ from it self, than Number and Duration makes those things to differ that are numbred or do endure; and consequently the difference there is betwixt the Soul and its Faculties, is only a Distinction of Reason, that is, a notional distinction.

Seeing therefore that our Bodily Members are devoid of Sense, and that the Soul alone is endued with that Faculty, it remains for us to examine, what inward instrument the Soul makes use of for the perception of things, and how the Species or representations of Objects are conveyed to it. For the motion of the outward Organ, is only performed in the Brain, because there the Soul ex-

I.
The Soul is
not really
distinguished
from its
Faculties.

II.
What the
Common
Sense is
and how
the same is
exercised.

exerciseth its *Functions*. Wherefore this *Sense* is called the *Common Sense*, because it receives all the *Species* of the outward *Senses*, and so reacheth their *Objects*. For when we represent to our selves any *Object*, as for Example, a *Man*, we do not only seem to behold the colour of his *Face*, and *stature* of his *Body*; but also to smell the *Odours* he is us'd to have about him, to hear him *speak*, to taste the *Food* he eats, and to feel the *Softness* or *Roughness* of the *Cloaths* he wears. For from what hath been said already, it cannot be question'd, but that the *Brain* is the *Organ* of the inward *Sense*, forasmuch as the *Nerves* proceed from it, as *Threads* from a *Distaff*, whereby the *motions* of the outward *Senses* are transmitted.

Yet is not the whole *Brain* the *Seat* of this Inward *Sense*, but only some part of it; for otherwise the *Optick Nerves*, and the *Pith* of the *Back-bone*, as being of the same Substance with the *Brain*, would be the Residence of the Inward *Sense*. Now this peculiar place of the *Soul's* Residence, is the *Conarion*, or *Glandula Pinealis*, a certain *Kernel*, resembling a *Pine-Apple*, placed in the midst of the *Ventricles* of the *Brain*, and surrounded with the *Arteries* of the *Plexus Choroides*. The Reason why we take this *Kernel* to be the peculiar *Seat* of the *Soul* is, because this part of the *Brain* is *single*, and *one only*. For whereas all the *Organs* of the *Senses* are *double*; there can be no Reason given, why we should not perceive two *Objects* instead of one; but only because both these Impressions are transmitted to a certain part of the *Brain*, which is *single* and *one only*, wherein both are conjoin'd. Furthermore, it is also requisite that that part should be *moveable*, to the end that the *Soul* by agitating of it immediately, might be able to send the *Animal Spirits* into some certain *Muscles*, rather than into others. And forasmuch as this *Kernel* is only supported by very small *Arteries* that encompass it, it is certain that the least thing will be sufficient to put it into *motion*. And therefore we conclude, that this inmost part of the *Brain* is the *Seat* of the *Soul*, in which it exerts its operations of *Understanding* and *Willing* of whatsoever proceeds from the *Body*, or tends towards it.

Accordingly the *Common Sense* may be described to be an *Internal Sense*, whereby all the *Objects* of the *External Senses* are perceived and united in the midst of the *Brain*, as the common Center of all Impressions. Or the *Common Sense* is nothing else, but the concurrence of all motions made by the *Objects* upon the *Nerves*, in the *Conarion*, happening at the same time that the *Objects* move the *Senses*.

Neither doth the *Smallness* of this *Kernel* hinder its being the Instrument of the *Common Sense*; but on the contrary, those Persons are the most stupid in whom this *Kernel*, because of its bigness, is not so readily moved; and those the most witty and apprehensive in whom this *Kernel* is less, because it is so much the more easily moved: And tho' it were much less than it is, yet would it be big enough with respect to the several Points of the *Ventricles*, and to the *Pipes* of the *Nerves*.

The Foot-steps of *absent Objects*, which are laid up in that simple and pliable Substance, by the assistance of the *Nerves*, are called *Species* and

Phantasms, by *Philosophers*. They preserve the memory of things before perceived by us, and represent them to us, as oft as we think of them.

Phantase or *Imagination*, is nothing else, but a certain application of the *Knowing Faculty* to the *Body* (*viz.* the *Brain*) which is intimately present to it. Or it is an *Internal Sense*, whereby the *absent Objects* of the *External Senses* are represented present to the *Brain*, by reason of the Foot-steps of former Impressions. For the *Species* of the *Imagination* make us to conceive the *Image* of these things as present to the *Eye* of our *Mind*. For when we do imagine any *Object*, the *Soul* turns it self to the *Body*, there to behold the *Image* or *Representation* which it apprehends, as intimately present to its *Thoughts*.

But here ariseth a Difficulty. For if it be so that the *Imagination* be performed in the *Brain*, how comes it to act upon distant *Bodies*? as it happens in some *White-Women* that bring forth *Blacks*, and *Blacks* that bring forth *White Children*? And in those spots or marks which *Longing-Women* impress upon their *Children*; or that an *Adulterous Woman* brings forth *Children*, that are like her *absent Husband*?

This Difficulty will be easily resolved; if we suppose that the *Imagination* hath not only a great force over the *Brain*, but also over the whole *Body*; for seeing that the *Nerves*, as so many *Strings*, are extended throughout the whole *Body*, they readily convey the *Animal Spirits* from the *Brain* to the *Muscles*, together with the *Affection* impress'd on the *Brain*. And by the same means the *Imagination* moves the *Humours* of the *Body*, and by this different agitation of the *Humours*, the *Blood* becomes alter'd, and consequently the *Skin* and colour of the *Hairs* also become changed. Yea, without this change or alteration of the *Blood*, some *Impression* may be conveyed through the *Arteries* of the *Woman* that is with *Child*, to some certain part of the *Birth* in the *Womb*, and leave a Mark there. See my *Natural History*, concerning *Man*, Chap. VI.

Memory is that Faculty of the *Soul*, which repeats things perceived by former Sensations; or it is the calling to mind of known and past things. And differs from the *Imagination* only in this, that from the Foot-steps of former Impressions on the *Brain*, it doth represent as present to it self, *Objects* that were formerly offer'd to it: Whereas *Memory* consists in this, that the *Pores* of the *Brain*, through which the *Spirits*, determin'd by the *Pine-Apple-like Kernel*, have pass'd, are thereby become dilated, and consequently more fit to admit the same *Spirits*, repassing that way another time.

And accordingly *Memory* is twofold, *viz.* Intellectual and Animal. Intellectual is that which belongs to *Angels* and *Souls*, by means whereof they can represent to themselves, the *Thoughts* they formerly have had concerning *Spiritual things*; and this kind of *Memory* doth not stand in need of any *Bodily assistance*. The *Animal Memory* is that which is common to us with *Brutes*, and is performed by means of the *Brain*, and the Foot-steps impress'd upon it. For *Sensual* or *Corporeal Memory* imports nothing else, but a certain facility remaining in the *Pores* of the *Ventricles* of the *Brain*, to open themselves again, by reason of their having been

III.
The Glandula Pinealis, or Pine-Apple-like Kernel, is the Seat of the Inward Sense.

IV.
What the Common Sense is.

V.
The Little-ness of this Kernel is no hindrance to its being the Instrument of the Common Sense.

VI.
What Species and Phantasms are.

VII.
What Imagination is.

VIII.
The Strength of the Imagination.

IX.
Wherein the Nature of the Memory doth consist.

X.
Memory is either Intellectual or Animal.

been before opened by the *Animal Spirits*. Or, to speak more clearly, the Foot-steps of the *Animal Memory* are those, which the passage of the *Animal Spirits* hath left betwixt the *Fibres of the Brain*, through which they have passed before, so as to go out by the said *Pores* again, as they at first enter'd in by them; by which means it comes to pass, that these *Spirits* do more easily enter these *Pores*, than others; as *Paper* that hath been once folded, is more apt to run into the same Folds that hath been formerly made in it.

XI.
How the
Foot-steps
of Memory
are formed
in the
Brain.

Figure
75.

To understand how this is done, we are to imagine, that after that the *Spirits* that go forth from the *Glandula Pinealis H*, have left some impression of a *Species*, or some particular Foot-steps of their passage, they do pass from thence through the Points 2, 4, 6, 8, and into the like *Pores and Intervals* as are found betwixt the *Filaments*, whereof the portion of the *Brain EE* doth consist. Which *Spirits* have the power of dilating the said *Intervals* in some sort; as likewise of folding and diversly disposing of the *Filaments*, against which they push in their passage, according to their different motions, and the various openings of the *Pipes* through which they pass; that there also they may impress *Figures* like to those of the *Objects*.

XII.
How they
are trans-
mitted to
the Brain.

We are to conceive therefore, that the *Figure* impress'd by the *Object AB, CD*, upon the *Fibres* of the *Optick Nerve*, which it moves or agitates in the Surface of the *Retina 1, 3, 5, 7*, must delineate another *Figure* like it self, in the inward Surface of the *Ventricles of the Brain 2, 4, 6, 8*, where the said *Fibres* are terminated: Whence it comes to pass, that the *Animal Spirits*, which reside in the *Kernel H*, must more swiftly pass out of the *Pores*, that answer to them, than they did before; and that too in the same form or figure of the opening. And thus their Course produceth another like to it upon the *Glandula H*, which is that Form to which the *Thoughts* of the *Soul*, which depend on the *Body*, are immediately linked.

XIII.
How these
Foot-steps
of the
Memory
are pro-
duced.

But yet the *Spirits*, which make their way through the Passage 2, 4, 6, 8, though they may be of some force to dilate the passages of the *Fibres* a little; yet they have not power enough at the first stroak, to impress their figures upon the *Fibres*, which are in the Substance of the *Brain*, with so much facility or perfection, but by degrees perform the same more accurately, according as the *Action* of the *Spirits* is either stronger, more lasting, or more frequently repeated. Whence it follows also, that these *Figures* are not so easily obliterated, but do abide there: So that by means of them, *Species*, that at any other time have been impress'd upon this *Kernel*, may a long while after be again represented or formed there, even tho' the *Objects* be absent. And tho' these Passages should afterwards chance to be shut up again, yet they still retain a greater facility or readiness to be open'd, than other Neighbouring passages that were never yet opened. As if many *Needles* should pierce the stretched piece of *Linnen A*, the Holes which the said *Needles* had made in it, would remain open, even after that the *Needles* be taken away: Or, if they should be closed, yet there would some signs thereof remain in the *Cloth*, which might very easily be opened again. And it is to be noted, that if only some of these *Holes* should be open'd

Figure
76.

again: As for Example *a*, and *b*, this would be sufficient to make others of them, such as *c*, and *d*, to be dilated again at the same moment of time; especially if all the foresaid *Holes* had been often open'd, and that all of them had been usually opened together. Yea, there is a greater facility or readiness in the *Pores* of the inward Substance of the *Ventricles* of the *Brain*, of opening themselves upon the like *Action*, than there can be in the *Linnen Cloth*; for that whilst the *Spirits* do again open some of those Passages, the said *Spirits*, because they are diffused every way, do in some sort follow the same Track (in the same manner as we see that the *Sound* or *Wind* follows the motion of *Running-Waters*) and by this means do open the Passages again that are about them, because of the easiness they find to enter in by them.

Moreover, we are to take notice, that in case only some Passages were opened, after the same manner others would also be opened at the same time; especially if they had been frequently opened before, and all of them together. Thus when 2 *Objects* have delineated their *Species*, and that the 2 Ranges of the *Spirits*, that have framed them, be somewhere joyned in the Substance of the *Brain*, it is sufficient if one of them only be brought to the *Pine-Apple-like Kernel*, for the stirring up again of the said *Actions*, which had their rise from them both. As when we have seen the *Nose* and *Eyes* of any *Face*, we readily apprehend the *Mouth*, *Forehead*, and other parts of it, and imagine them as present to us, because we are never us'd to see any of these Parts by it self, but all of them together.

From what hath been said, we may easily apprehend, that the *Brain* ought not to be over moist or soft, that it may the better retain the *Species* impress'd upon it. Thus we see that *New-born Children*, whose *Brain* is in a manner altogether watry, cannot retain any impression that is made upon it; and for the same Reason it is, that tho' *Children* afterwards do with ease enough learn things by *Heart*, yet they as easily forget them again. Whereas on the contrary, those who have harder and drier *Brains*, do long retain the Marks once impress'd upon them, but cannot without difficulty receive any new Impressions. Hence it is that very *Old Men*, because of the *Driness* of their *Brain*, become wholly deprived of their *Memory*, neither can retain ought of those things that are committed to them; and yet are very retentive of those things they have long since committed to their *Memories*; because their *Brain* being grown hard, doth more firmly preserve the Impressions made there.

CHAP. XXIII.

Of Health and Sicknes.

HHealth is nothing else, but that State of an *Animal*, wherein all its Powers can discharge their Functions, as they ought. Or, it is a certain disposition of *Body*, and *Harmony* of its parts, whereby its fitted forth, exerting and performing of all Actions, according to the Laws of Nature. For as *Harmony in Musick* consists in an agreeable concent of Sounds, whilst every one ob-

I.
What
Health is.

XIV.
How we
can remem-
ber two
Objects at
one and the
same time.

XV.
What ought
to be the
Tempera-
ment of
the Instru-
ment of
Memory.

serves such a degree of *Depth* and *Height*, that it doth not go beyond, or fall short of a due proportion: So we call that a State of *Health*, when every *Humour* and *Quality* observes that exact degree of *Intention* and *Remission* that they never exceed in, or fall short of a congruous proportion. Hence GALEN in his *first Book of the preservation of Health*, defines *Health* to be such a constitution of *Body*, in which we are neither sensible of any Pain, neither are we hindered in any of the functions of *Life*: And that therefore those *Men* are to be accounted *Healthful*, who without any pain or impediment can perform all the necessary functions of *Life*.

II. There are 2 things more especially that concur to the constituting of *Health*, viz. a due *Temperament of the Humours*, and composition of the parts. By the name of *Temperament* we understand a certain mixture or Union, according to which the *Natural Functions* are well and duly performed. And consequently the distemperature of the *Humours*, as the Excess of *Choler*, *Phlegm* or *Melancholy* do spoil *Health*, and hinder the use of our *Natural Faculties*. A congruous constitution or composition of the *Parts*, consists in a due *Number*, *Magnitude*, *Situation*, *Figure* and *Connexion* of the several *Parts* and *Organs*, and such a disposition of the *Fibres*, as the *Natural Faculties* stand in need of to discharge their several *Functions*.

III. Physicians commonly distinguish *Health* into that which is *Best* and *Absolute*, which consists in a manner in an indivisible point, from which, if there be never so small a varying or deviation, the same is esteemed to be a *Sickness* or *Disease*; and the *Other* which is also *perfect*, tho' probably it may admit of some excess or defect, but not so great, as that it can be accounted for a *Sickness*, tho' it may cause some little hinderance in the natural functions, or cause some inconsiderable Pain. The former of these States of *Health* is not to be found in *Nature*, and can only be conceived in our *Minds*: Tho', as GALEN saith, it may serve for a *Rule*, by which we may measure or compute the greater or less degrees of *Health*. The *Latter* is attributed to every *Man*, and is not found in a lower degree except it be accidentally. For *Nature* always affects that which is best; and if at any time it cannot effect what it intends, yet it always performs the best it can.

IV. Many things are conducive to the preserving of the *Health*. First the *AIR*, which being taken in by the *Mouth* and *Nostrils*, enters the *Body*, and is necessary to rid the *Blood* of fuliginous steams by means of the *Lungs*; which should it not be continually done, as well the Branches of the *Venal Artery* as of the *Arterial Vein* would be obstructed, and not only *Health*, but also our *Life* would be in danger.

Secondly, Care is to be taken about our *FOOD*; for seeing that we stand in need of *Food* to repair and restore the *Consumption* made by our *Inward Heat*, we are to mind that it be taken in such *Quantity*, *Manner*, *Time* and *Place* as may be most conducive to the *Health* of our *Bodies*. For neither must it be taken in so small a *Quantity*, as to famish or weaken our *Bodies*; nor so copiously, as thereby to overcharge our *Stomachs*; nor

so frequently as to disturb the *Digestion* of the *Food* we have last taken; nor so seldom as to defraud our *Stomachs* of their due allowance.

Thirdly, The Retention and Voiding, or Excretion of our *ALIMENTS*; for seeing that the purest and best of the *Food* must be changed into the *Substance* of the *Body* that is fed, it is of absolute necessity that it be retained in the *Body*: And since it cannot be so pure, but that it must contain some *Heterogeneous Parts*, the same must be voided, lest by overlong stay in the *Body* it should putrefie, and disturb the *Oeconomy* thereof.

Fourthly, Moderate *EXERCISE*; for motion is a great help to excite *Heat*, and to open those obstructions, which hinder corporal Functions. But yet on the other hand, overviolent and unseasonable *Exercise*, wastes the *Body*, and by disturbing the inward *Oeconomy*, frequently is the cause of *Diseases*.

Fifthly, *REST*; for seeing that as long as we are awake, the *Spirits* continually course it through the *Organs* of our *Body*, this causeth *Weariness*, which must be restored by *Rest* and *Sleep*. Wherefore whenever we watch too long, our *Spirits* become dissipated, the strength of our *Body* weakened, our concoction is hindered, and our whole *Body*, and more especially our *Brain*, is thereby dried.

Sixthly, moderate *PASSIONS* and *AFFECTIONS*, especially those of *Joy* and *Cheerfulness*, which promote and help the motion of our *Spirits*, and cherish and recreate all congruous functions. But of all things, nothing is more conducive to *Health*, than for every *Man* to take heed to himself, and carefully examine what he finds *Good* or *Hurtful* to him, endeavouring always to avoid the one, and procure the other, and to use it in due time and manner. And accordingly CICERO tells us in the 4th. Book of his *Offices*, *Health* is maintained by the knowledge of ones own *Body*, and by making observation of those things, which are wont to be *Good* or *Hurtful* for us, as also by continual *Temperance* and *Continence* throughout the whole course of our *Lives*, together with the care to keep our *Bodies* neat and cleanly.

SICKNESS on the contrary is such a State of the parts of our *Body*, whereby they are hindered from the due performance of their Functions. And therefore whatsoever overthrowes the *Temperament* of the fore said *Humours*, or the composition of the *Parts*, is called *Sickness*. Tho' *Sickness* doth attack the whole *Man*, yet doth it only consist in the *Body*; because those Distempers which seem to affect the *Soul*, are only some consequences of *Bodily Sickness*; as appears manifestly in that as soon as the *Body* is cured, the griefs and uneasiness that were found in the *Soul* do immediately cease, and no longer afflict it.

Sickness is commonly divided into two General Heads, viz. into *Sickness* of the *Similar* and *Dissimilar Parts*. *Sickness* of the *Similar Parts*, is called a *Distemper*, when it is such as that it sensibly hurts our *bodily Actions*, as when any *Quality*, by Example, that of *Heat* or *Cold* doth exceed. And this *Distemperature* is either *Manifest* or *Hidden*. *Manifest* is that wherein the *Qualities* that exceed are known. *Hidden*, when

V. What Sickness is, and that it only resides in the Body

VI. Of the two General Heads of Sickness.

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by

VII.
Diseases
of the Dis-
similar or
Organical
Parts.

by reason of the ignorance of the exorbitant *Qualities*, the cause of the *Distemper* cannot be found out.

The other kind or General Head of *Diseases* is of the *Organical Parts*, which are said to be *vicious* or faulty, with respect to their *Conformation*; or with respect to their *Magnitude*, when they are either greater or less than they ought to be; or with regard to their *Number*, when therein they exceed, or are defective; or as to their *situation*, when they are not rightly placed; or as to their *Figure*, when it is not such as it ought to be; or with respect to their *Connexion*, when they are at too great distance from each other, or if they be overmuch crowded together, stretched, compressed, loosened, or grown too stiff.

VIII.
Some Dis-
eases afflict
only some
parts, o-
thers the
whole Body.

There is also another Division of *Diseases* into Universal and Particular: *Universal Diseases* are such as afflict the whole Body, as *Agues* and *Fevers*. Others *Particular*, which only affect one part of the Body, as the *Brain*, *Lungs*, *Throat*. But to the end that we may be able to understand the chief *Diseases* of the Body; we shall consider them in the following Order.

IX.
Pain of the
Head, or
Headach.

The First *Disease*, and which hath its seat in the *Membrans* of the *Head*, is the *HEADACH*, which is a *Pain*, or troublesome *Sensation* of the *Head*, proceeding from the *Exorbitant Figures* of the *Blood*, which spoil the *Temperament* thereof. For when the *Animal Spirits*, being too violently agitated by reason of a too *Choleric* and *Glewy Arterial Dew*, are driven through the *Arteries*, to the *Head*, and the *Filaments* and *Membrans* of the *Brain*, they forthwith disorderly twitch, corrode, prick and cut the same, and finding the *pores* through which they would make their way, not corresponding with them in *Greatness* and *Figure*, they by their force slit them up, and thereby produce an exquisite pain in the *Head*. Hence in the cure of this *Disease* there is made use of *Blood-letting*, and other things conducing to the changing of the *Distemper* of the *Blood*, and to drive away the *sharp particles*, which are got into the most sensible *Membrans* of the *Brain*. *Purging Medicines* are also used, whereof some are more proper to expel these, and others, other *particles*; such as are *Aqueous* and *Oleous Medicaments*, which also stop the too swift motion of the *Animal Spirits* in the *Blood*.

X.
Phrensy.

PHRENSY or Raving is a violent agitation of the *Brain* and *Membrans* thereof, caused by the excessive heat of the *Blood*, and its being filled with *sharp* and other malignant *particles*, which entering the *Pores* and *Membrans* of the *Brain*, do frequently cause an *Inflammation* there. Which then happens when *Triangular Particles* light upon *Round Pores*, whereupon in every such *Pore*, there are left three little spaces, because of the threefold surface, for the filling up of which spaces, the *subtil matter* presseth in with more abundance, by the rushing in whereof the *Parts* and *Humours* become agitated and disturbed. Whereupon the *Glandula Pinealis* is no longer in a condition to discharge its function, because these *Animal Spirits* are no longer subject to any *Rule*, but as *Refractory Soldiers* and *Deserters*, cast off the *Yoke*, and course it up and down without *Rule* or *Discipline*. Wherefore *Opiates* are recommended for the cure of this *Disease*, which both reduce

the *Raging Spirits* to rest and composure, by closing up the *Nerves*, as it were, with *Bird-lime*, and stop the irregular motion of the *sharp particles*, which before did cut the *Fibres*, and little *Branches* of the *Nerves*, that those *Fibres*, which before were stretched out like *Cords*, do run together into twisted *Knots* and *Bunches*, which *Knots* stop the passage of the *Spirits* through the *Nerves*, and so hinders them from being transmitted to all the *parts* of the *Body*, and consequently from discharging the wonted functions. *Refrigerating* or *Cooling Medicaments* are likewise of use in this distemper; as for Example, the *Chymical Preparation* called *Nitrum Perlatum*, which being dissolved in *Water*, is found to be of very good use in this case, because it fixeth the *Spirits* and the *Blood*, and at the same time opens *Obstructions*; as also *Distill'd Vinegar*, *Antimony* *Diaphoretick*, and *Powder of Pearl*, *Coral*, &c.

MELANCHOLY which is commonly defined to be a *Doating*, without a *Fever* or *Raving*; is a *Delirium* or *Doating*, proceeding from the sadness of the *Patient*, whereby the *Animal Spirits* are moved more slowly than they are wont. This distemper of the *Blood*, is commonly the product of a vicious *Sowre Humour* in the *Blood*, by means whereof the *Animal Spirits* are darkened and condensed, which roving through the former footsteps left in the *Brain*, and rebounding from them, represent the same *Images* to the *Soul*; and accordingly *Melancholy Persons* think the things they have once conceived to be always present with them. Wherefore *Altering Remedies* are much used in this *Disease*, and particularly such as abound with much *Volatil Salt*, as all *Spirituous Matters* do, as by Example, the *Juice* of *Betony*, *Scurvygrass*, *Brooklime*, *Chickweed* and such like, by means whereof the *Ropy* and viscous distemperature of the *Blood* is amended.

MADNESS is another kind of *Doating*, accompanied with great *Rage* and *Alienation* of *Mind*, without a *Fever*, proceeding from the irregular motion of the *Animal Spirits* being inflamed, and turned into a fiery *Nature*. For the *Spirits* being excited by some outward cause, and inflamed, range about through the *Brain*, but more especially about the *Glandula Pinealis*, and rushing like *Lightning* into the *Brain* and *Muscles*, do put the *Glandula* out of the *Souls* command, which being deluded by these *Spirits*, and deprived of all her command over the *Body*, can no longer guide or govern it; whence proceed so many undecent *Gestures*, *Fightings*, *Quarrels*, *Bawlings*, &c. In order to the stopping of this Effervescence of the *Blood*, ponderous *Remedies* are made use of, as *Lapis Prunella*, *Saccharum Saturni*, or *Sugar of Lead*, *Crabs Eyes*, *Laudanum Opiatum*, *Sanguis Draconis*, &c. *Decoctions* also made of some ponderous sorts of *Wood*, are profitable in this case, as which by their heavy and hard *Particles*, do stop the motion of the *Blood*.

LETHARGY is an irresistible inclination to *Sleep*, accompanied with great forgetfulness, caused by an *Obstruction* of the *Pores* of the *Brain*, by a thick and gross *Humour*, and the want of *Animal Spirits*. This *Disease* is also in a great measure caused by *Streams* and *Vapours* that are mingled with a *Slimy*, *Ropy* *Due*, which being condensed into *Water* overwhelm the *Brain*, and the

XI.
Melancholy.

XII.
Madness.

XIII.
Lethargy.

the Soul together with it. And accordingly this Disease is cured by Volatil and Aromatical Remedies which restore the Spirits, and by their volatility open the Pores, and cut the Viscid or Slimy Matter: Such as are all Spirituous Matters, all Volatil Salts, especially such as are Aromatical and Oleous, also the Wood Guajacum and Sassafras, the Roots of Masterwort, the Herbs, Balm, Betony, Organy, Sage, Marjoram, Thyme, Rosemary, &c.

XIV.
Coma Vigil, or the Waking Drowsie Disease.

COMA VIGIL or the Waking Drowsiness, is a Distemper accompanied with a strong Inclination to Sleep, wherein the Patient lies drowsing with his Eyes shut, without being able to fall asleep. This Disease is caused by too great a dilatation of the Pores of the Brain, from the too much inflamed and agitated Animal Spirits. Wherefore in this Sickness it is necessary to purge the inflamed Choler, which puts the Blood into a violent Fermentation; and to correct the said Humour by Acids. For the best way to cure this Disease is by such Remedies as do allay and assuage the sharpness of the Humour, and Cordials that restore strength, as also by Sudorificks, which volatilizing those sharp particles, drive them by sweat out of the Body.

XV.
Cataleptis.

CATALEPTIS is a suddain Detention or Immobility of the Body, accompanied with a weakening of the Senses, whereby the Patient retains the same figure of the parts of his Body, which he had in the first moment when he was seized with this Distemper. This Dreadful Disease is not caused by a freezing of the Animal Spirits, and the Humours that are in the Body, or from a Vapour that congeals the Spirits, as the Galenists do suppose, seeing that no such thing can happen to the Spirits, but because the Animal Spirits are no more subject to the command and guidance of the Soul, by reason of the Obstruction of the Glandula Pinealis, and therefore cannot move the parts as they used to do. So that the Cause of this Distemper is no other, but the Obstruction of either side of this Kernel. Wherefore for the taking away of this Obstruction, and to restore the Animal Spirits to their Due and Regular Motion, Volatil Salts are prescribed, and Cephalicks, or Medicaments appropriated to strengthen the Brain, and the Glandula Pinealis in particular, the proper seat of the Soul. Strong Motions and Frictions, or Rubbings of the Body are commended with hot and course Linnen Cloath.

XVI.
The Vertigo.

The VERTIGO is a Sickness wherein all Objects about us seem to turn round, caused by the undue circular motion of the Animal Spirits. Because in this Distemper the Humours and Blood are so tossed and agitated, that by their irregular motion they affect the Roots of the Nerves, and pressing and crowding upon one another, make it appear as if all Visible Bodies turned round. Which crowding and compression proceeds frequently from the Depravation, and sometimes from the Abundance of Blood. And consequently the cure of this Disease is commonly undertaken by Spirituous Medicines that remove Obstructions, by Cephalick and Aromatical Balsams. But if this Disease be caused by an over-great abundance of Blood, then the breathing of a Vein is necessary; if from some depraved Juice lurk-

ing in the Stomach, Vomits are most proper, as also Marmelad of Quinces, Bisket and Crusts of Bread to correct the said vitiated sharp Humours.

EPILEPSY or the Falling Sickness, is a convulsive motion of all the Parts of the Body, more especially of the Hands and Feet, accompanied with a deprivation of the Inward and Outward Senses. This Disease proceeds from a Depravation of the Blood, and an Obstruction in the Solid Parts, caused by square figured Particles, which afflict the Nerves with their Angles, which way soever they apply to them; as also by hooked particles, which being once fastned in the Fibres of the Nerves, cannot so readily be disintangled thence. For the smoothing, and infolding of which particles, the Decoctions of several sorts of Wood, and other Cephalicks are made use of; whereby the sharpness of the Humours is blunted, and the points of the particles smoothed, as may be seen in a Knife, Sword, Needle, &c.

XVII.
The Epilepsy, or Falling Sickness.

APOPLEXY is a suddain ceasing of all Animal Actions, viz. Sense and Motion, with the Hurt of the Principal Faculties, proceeding from an over-great Dilatation and opening of the Pores of the Brain, and the Plexus Choroideas. For by this means is often caused a total Obstruction of the Brain, which is the Beginning or Rise of the Nerves, by a foreign Humour flowing into the Brain, which stops up the way for the Animal Spirits, whereupon all the Members of the Body flag, and become immoveable; as Sails fall flat, and hang limber, when the Wind fails, that before distended them. According to this notion of this Disease, liberal Blood-letting is very conducive in that Apoplexy, which is caused by too great abundance of Blood; and a more moderate Blood-letting in that which proceeds from abundance of Phlegm. Rubbing of the parts with Hot Cloaths are also commended, and with Spirituous Liquors; for by these the Animal Spirits are excited, and the clogging matter that obstructs the Nerves is by this means the better removed. Gentle Glisters are also of good use in the beginning of this Distemper, and afterwards such as are more strong and vehement.

XVIII.
Apoplexy.

The PALSIE is a Privation of Sense and Motion, either throughout the whole Body, which is less frequent, or in some Members only proceeding from the want or weakness of the Animal Spirits. For where the Spirits are either altogether wanting, or not in sufficient Quantity, the Nerves and Muscles become limber and flaggy, by which means Sense and Motion, either altogether cease, or are remarkably weakened. Wherefore in order to the Cure of this Distemper Physicians take away a little Blood, to free the Passages from Obstructions, and afterwards exhibit Medicaments proper to correct the thickness and clamminess of the Blood, and to make it more thin and fluid; such as are altering and inciding Cephalicks and Aromaticks appropriated to the Brain and Nerves. This done, the Pores of the Brain, and Pipes of the Nerves may be opened by Sudorificks, especially such as consist of hard and stiff parts; viz. Sassafras, Guajatum, Sarsaparilla, &c. to the decoctions whereof some Salt of Tartar may be added, for to make the extraction the stronger by opening of the Pores of the said Woods.

XIX.
The Palsie.

CON-

XX. *Convulsion.* **CONVULSION**, commonly call'd the *Cramp*, is an involuntary, continual and painful Contraction of the Muscles, proceeding from a rough, cold and thick Windy Vapour, puffing up and distending the Parts. To the removing of this Distemper, are made use of all Medicaments that open Obstructions and break Wind, whether inward or outward, Volatile Salts, and all Cephalicks.

XXI. *The Night-Mare.* The **NIGHT-MARE**, is a great diminution of the Animal motion, and of those parts that are serviceable to the forming of the Voice and Respiration, and more especially the Nerves called Phrenici and Recurrentes, proceeding from the want of the Influx of Spirits, with the false Imagination of an Heavy weight lying upon one, in the appearance of some frightful Spectre. For whenever during Sleep, the Spirits do not flow freely into the Muscles, then such a Motion is produc'd, as whereby the Soul judgeth some great Burthen to lye upon it, which hinders the free motion of the Midriff. Now this sense of being strangled or choak'd is occasion'd, by reason of the Spirits being hindred from their free ingress into the Muscles of the Throat, which thereupon flag and fall down, and so produce this Sense of Strangulation. In this Disease, the use of Volatile Salts is much commended, especially joyned with Spirituous means; and so likewise Aromatics, and other Medicaments, proper to incide and attenuate, and consequently to open the Obstructions of the Pores of the Midriff.

XXII. *A Catarrh, or Rheum.* A **CATARRH** or Rheum is an Effusion of the sharp particles of the Blood, or serous part of it, in every part of the Body, being because of its long stay there coagulated, and producing a pain in the Part either with, or without a swelling. For when the due and regular mixture and consistence of the Blood is spoiled by Serous and Pituitous matter, many sharp particles are cast out into the Glandulous parts, which by their acrimony, and other manifold malignity twitch the Membrans, whereupon follow frequent Sneezing, troublesome Coughing and Hoarsness. In the beginning of this distemper, mild Catharticks are much commended, as Pilule de Succino and other Aloeticks; Blisters also, and Issues, and Scarifications are commended in order to the Evacuation of the serous peccant Humour. Moreover all Oleous and Fat things are of good use in this case, because that by the softness of their parts, they do infold and blunt the sharp points of Heterogeneous saline particles in the Blood; as likewise thick and Earthly Medicaments as Crabs Eyes, Terra Sigillata, common Bole, &c. because these are proper to file and rub off the sharp corners of Salts.

XXIII. *Cough.* Having thus handled the Diseases and Distempers of the Head, we next proceed to consider those of the Breast or Chest, and here we shall in the first place Treat of that Distemper commonly called a Cough, which is a more frequent, uneven and Loud expiration or out-breathing, whereby a great part of Spirits bursting forth violently, endeavour to cast forth some sharp, and troublesome Excrements, caused by the sharp, and pricking particles of the Blood, which by the Circulation of the Humours, are carried into the Muscles design'd for inspiration or expiration, and being there in greater quantity than ordinary, do painfully twitch the Parts, and stir up a Convulsive motion. For

the sharp particles like so many Knives or Prickles, being entred into the substance of the Lungs and the Fibres of the Branches of the Windpipe, do necessarily produce a kind of Convulsion, viz. a Cough. Wherefore, in order to the blunting of these sharp pointed Particles sweet things are commended, and Opiats, which do also allay the sharpness of the Humour. Vinegar of Squills is also of good use, especially where the Patient is troubled with tough Phlegm. And for a Purge Mercurius Dulcis is commended, because it doth cut Phlegm and evacuate it.

ASTHMA, or Tiffick, is a difficult and thick fetching of ones Breath, with, or without a Fever, sometimes with great wheezing, and other times without it, proceeding from an ill affection of the substance of the Lungs, and the Intercostal Muscles, serving to Respiration. For whenever the Nerves, that belong to the Intercostal Muscles, and other Organs serving to Respiration, are obstructed, it produceth difficult Breathing. For the removing of which Obstructions, Physicians commend the use of mild Aromatics, and Volatile, Oleous Salts, which by their Volatility are very proper to pierce the windings of the Lungs, and to open their Obstructions, caused by tough and slimy matter. The fore-mention'd Decoctions of Wood are likewise very useful, as consisting of hard, ponderous and stiff Particles, which by their irregular figure and heaviness drive through the Pores, resolve the viscid or tough matter, and restore the Blood to its due fluidity.

The **PLEURISIE**, as also the **PERIPNEUMONIA**, is an Inflammation, the one of the Pleura, (that is, the Skin that covers the Ribs;) the other of the Lungs, accompanied with the greatest difficulty of Breathing, a high Fever, a continual Cough, sometimes with Frothy Spittle, and frequently also with that which is Bloody, with great Pain, Heaviness and Anxiety about the Breast and Heart, caused by a sharp, distending, pricking and corroding Matter. For this Matter is nothing else in the Pleurisie, but the sharp-pointed and volatile Parts of the Blood, transmitted to the Membrans that cover the Ribs and the intercostal Muscles; whereas in the Peripneumonia, or Inflammation of the Lungs, they are conveyed into the very Substance of the Lungs, and extravasated thence. Wherefore in either of these Distempers, it is proper to breath a Vein, as well to allay the furious effervescence of the Blood, caused by the foresaid Particles, as to evacuate some part of them. And to alter and correct the sharpness of the Particles of the Blood, testaceous Powders are commended, which do not only imbibe the acidity of the Blood, but also by their ponderosity, serve to dissolve the grumous and coagulated parts thereof.

PTHISIS, or the Consumption of the Lungs, is a wasting of the whole Body, with a slow or Hectick Fever, and Cough, with the spitting of Purulent matter, caused by the sharp Particles of the Blood, fretting and corroding the Lungs. For these malignant Particles, whether proceeding from the Arteries, or the Lymphatick Vessels, or from the open'd Imposthume of a Quinsie or Pleurisie, by effusion of the Purulent matter into the Cavity of the Breast, do there infect and taint the Lungs. And therefore to rid the Lungs of these

XXIV.
The Tiffick.

XXV.
The Pleurisie and Peripneumonia.

XXVI.
The Consumption of the Lungs.

these sharp and corroding *Particles* of the Purulent matter, Physicians prescribe hard and ponderous Remedies, viz. *Testaceous Powders*, and the *Decoctions* of several sorts of *Wood*, which have a virtue to imbibe and alter the sharpness of the Humour: *Mercurius Dulcis*, *Bole-Armenick*, and *Terra Sigillata*, are also commended in this Distemper.

XXVII.
Syncope or
Swooning.

SYNCOPE, or *Swooning*, is a sudden failing of the strength of the Body, caused by the Extinction for a time, or overwhelming of the vital Flame in the Heart. For the want of a sufficient store of *Spirits*, with the ceasing of the Circulation of Humours, and of the determination of the *Spirits* into the Muscles for that time, makes the Body fall down like the Trunk of a Tree. In this Disease are commended *Spirituos Medicaments*, and *Volatile Salts*, which are proper to kindle and feed the flame in the Heart; as all *spirituous*, cordial, odoriferous Waters, such as *Cinnamon-water*, *Aqua-mirabilis*, *Vita-Matthioli*, and the like, which rowze, corroborate and multiply the *Spirits*.

XXVIII.
Cardial-
gic or Pain
at the
Heart.

The Diseases of the Abdomen, or lower Belly, are **CARDIALGIA**, the Pain at the Heart, which is a painful Sensation at the Mouth of the Stomach, which by means of the Nerves is presented to the Soul. This Pain proceeds from the sharp and pointed *Particles*, that do prick, twitch and slash the Nerves and their *Fibres*, and consequently shake them; which Agitation being conveyed to the Organ of the Common Sense, it is vehemently moved thereby, and so represents to the Soul that afflicting Sensation, which we call Pain. Accordingly for the Cure of this Distemper, are prescribed several Remedies proper in *Convulsions*, but joyned with *Specifick Stomachicks* and *Opiates*, to which are frequently added the Powder of Native *Cinnabar*, *Amber*, *Man's Skull*, &c.

XXIX.
Singultus
or the
Hiccock.

The **HICKOCK** is a *Convulsive motion* of the *Midriff*, caused by tough and irregular *Particles*, twitching and forcing it to this disordinate motion. For the *Fibres* of the Nerves of the sixth Conjugation, distributed to the Stomach and the *Midriff*, are so vellicated in this Distemper, that by their motion communicated to the Brain, they frequently open those Pores there, by which the *Animal Spirits*, rushing violently towards the Mouth of the Stomach, contract the *Fibres* appointed for the expulsion of any offending matter, upwards, and make the Patients to explode the Air, contained in the Mouth of the Stomach with that vehemence, as constitutes the *Hiccock*; which ceaseth as soon as the sharp twitching matter is discharged by these repeated *Convulsion Motions*. For the correcting of these peccant particles all hard and ponderous matters, are commended, as *Crabs Eyes*, *Coral*, *Filings of Steel*, *Mercurius Dulcis* and *Opiates*.

XXX.
Diarrhea
a Scour-
ing or
Lask.

A **LASK** is the dejection of various and liquid Humours by stool, caused by the effervescence of the Blood, increased by the cholerick particles thereof, and irritating the *Fibres* of the Guts by their sharp points. For various Humours being precipitated through the Vessels which open themselves into the Guts, do vellicate their *Fibres*, and by this means make the *Animal Spirits* to rush down that way in greater abundance, whereupon a kind of *Convulsion* follows. In the dry Gripes

and the *Lienteria*, or that *Scouring*, when the Meat passeth away in the same manner as it was taken in, the ferment of the Stomach is faulty, as not duly digesting the Food put into it. In all Lasks or Scourings, at the beginning *Rhubarb*, *Falap*, and *Crabs Eyes* are commended, mixed with other proper Medicaments; and in the *Lienteria* and dry Gripes, *Balsamick Remedies* and *Stomachicks*, are given both inwardly and outwardly.

The **CHOLERICK** Passion is a depraved *Convulsive motion* of the Stomach and Guts, occasioned by sharp and pointed particles twitching the *Fibres* of the Stomach and the Gut called *Duodenum*, and contracting them upwards. For this twitching of the *Fibres* cannot continue long, without irritating of the *Animal Spirits*, and disturbing of them in their several Orders and Stations, and thereby causing them to produce these *Convulsive motions*. In order to the quelling of this fury of the disturbed *Animal Spirits*, *Bezoardicks* are commonly prescribed, and all ponderous Medicines, as *Crystal*, *Terra Sigillata*, &c.

XXXI.
Cholera or
the Chole-
rick Pas-
sion.

The **BLOODY FLUX** is an *Exulceration* of the Guts, accompanied with frequent and *Bloody Dejections*, and violent Pain and Gripings, caused by sharp particles that corrode and cut the small *Fibres* of the Guts. For the Hooked and Pointed *Particles* that are mixed with the Humours, do pierce and divide the Membrans of the Guts, and by this means cause an Ulcer therein. In order to the cure of this Disease, altering and Evacuating Medicines are made use of: and above all *Rhubarb*, because it leaves an adstringent Virtue behind it after Evacuation. *Emollient* and *Lenitive Medicaments* are likewise employed for the removing of this Distemper, and such things as promote Fermentation, as *Coral*, &c.

XXXII.
Dysenteria
or the
Bloody
Flux.

The **TWISTING** of the GUTS, is a most exquisite Pain of the small Guts, accompanied with a most obstinate stoppage of the passage downwards, and vomiting of the Excrements, proceeding either from an *Inflammation* of the Guts, or from their obstruction by some hard Excrements. This Disease is often caused by sharp Humours, sticking within the Membrans of the Guts, which cause the Expulsory motion of the Guts to be turned the contrary way, because of the irritated *Animal Spirits*, flowing from the Brain into the ascending *Fibres* of the Guts, which influx being perverted, the Excrements contained in them are voided upwards by the Mouth. In the cure of this dreadful and desperate Disease, Blood letting is made use of, to remove the *Inflammation*; and afterwards *Emollient* and *Lenitive Glisters* to evacuate and temper the sharp Humours, and to make the passages glib and slippery. For the same purpose *Lenitive Catharticks* are commended. *Crude Mercury* is also prescribed mixed with the Yolk of an Egg, that it may not stick to the Guts; and lastly *Narcoticks*, which both correct the sharpness of the Humours, and allay the *Convulsions* of the Guts.

XXXIII.
Iliaca Pas-
sion or the
twisting of
the Guts.

The **COLICK** is an afflicting and painful sensation in the Colon, or its neighbouring Parts, caused by a *Cholerick Humour* joyned with a corroding Salt. For there is a sharp Salt contained, not only within the Hollow of the Guts, but also betwixt the Membrans of them; which saline

XXXIV.
The Colick

particles, when they enter into such Pores, through which they cannot pass, they become, as it were, lock'd up there, that is, in the pores of the Coats or Membranes of the Guts, where they occasion a most acute Pain, by twitching and corroding the Fibres thereof. Wherefore to break the force of this sharp Humour, and to heal the hurt Fibres of the Nerves, several Asswaging and Anodynous Medicaments are prescribed, and sometimes Opiates, to give some respite to the Patient, and that the Physician may gain time to eliminate that foreign and præternatural Salt. Glysters also are commended, and other outward Applications to comfort the hurt Fibres, and to allay the violent motion of the Animal Spirits.

XXXV.
The Yellow
Jaundise.

The YELLOW JAUNDISE is an Ill habit of Body, staining the solid and fluid parts thereof with a yellow or black Colour, caused by the effusion of a sharp and depraved Gall. For the Gall, whenever its Particles are vitiated, either in their figure or motion; then that part of it which commonly promotes the Voiding of Excrements, is no longer sent that way, but continuing with the Blood, and circulating with it through the Body, stains the Skin with a yellow, and sometimes with a black Colour, that is, when fowr and gross Particles are mixed with those of the Gall. Wherefore in this Disease Purging Medicines are to be used at first, and particularly Infusions of Rhubarb and Senna; for otherwise, if they be boiled, or too strongly wrung out, they communicate those Particles to the Potion, that after Purging strongly bind the Body, which may be very hurtful.

XXXVI.
The Dropsie.

The DROPSY is a Swelling of the whole Body, and more especially of the Belly, caused by a Collection of watry Humours. For when a watry Humour stagnates and grows thick in the Belly, then it obstructs the Surface of the Inwards, together with the Peritonæum and Muscles of the Body, with a kind of slimy, pituitous Matter, which hinders that the Vapours and Steams arising from the Body, cannot be evacuated by insensible Transpiration; which is the Reason, why those that are troubled with this Disease, are so difficult to be brought to Sweat. Whilst therefore these small Vessels are burst and broken by the thick and tough Particles, the serous Particles drop down into the Belly; which being by degrees and continually increased, they produce the Dropsie, and other Ills in the Body. Wherefore for the Curing of this Disease, Medicaments that purge watry and serous Humours, are commended, as Pilule de Ammoniaco with Mercurius Dulcis; for the Mercury resolves tough and slimy Humours; and the Gum Ammoniacum is proper to consolidate the burst Vessels.

XXXVII.
Hypochondriacal
Melancholy
or the
Spleen.

HYPOCHONDRIACAL MELANCHOLY, or the Spleen, is a painful Sensation, caused by the Grossness, small Quantity, and Unevenness of the Spirits. For a sharp, fowr, and tough slimy Humour, lying hid in the Belly, breedeth Obstructions, whence all the Symptoms observable in this Disease do proceed. Wherefore also the Cure of this Distemper, is endeavoured by Decoctions made of the Barks of Tamarisks and Cappar-trees, of the Herbs of Germander and Chamæpitys, &c. If the Blood abound with vitiated Salts, volatile Acids, are commended, Antiscorbutical Herbs, and

more especially sulphurated Tartar. And because præternatural Acids generally have a hand in this Disease; therefore all those Medicaments are used, that are proper to alter and destroy the same; as the Alkalifate Salts of Herbs, Crabs-Eyes, Pearl, Diaphoretick Antimony, Salt of Tartar, and other such like.

The SCURVY is a Distemper of the Blood, and other Juices of the Body, caused by a præternatural Sourness, afflicting more or less all the Parts of the Body, and accordingly producing a vast variety of Symptoms. For the Cause of this Disease chiefly consists in that the Blood is impregnate with much fixed Salt, or acid Juice, and is frequently to be imputed to the Air, that is fill'd with such like Particles; which being drawn in by breathing, communicates the same to the Blood, and so forms this Disease. The Cure of this Disease is performed by Volatilizing of the Blood, and the fixed Salt, and by opening of Obstructions; to which end Blood-letting is prescribed, that the thicker part of the Blood being evacuated, better Blood might be furnish'd instead of it, by introducing of a volatile Acid.

The STONE is a Disease caused in the Reins or Bladder, by the Gravel or Stone, accompanied with a most exquisite Pain, by their grating against the Fibres of the Kidneys and Ureters. It is the product either of the too great abundance or thickness of the Blood, or the sharpness of the Humours. And therefore when the Patient, subject to this Disease, doth abound with much Blood, the Breathing of a Vein is necessary, and afterwards the Gravel and Stone must be evacuated by Diureticks and Lithontripticks: Emollient Glysters are also very much commended, for to make the Passages more slippery and open.

STRANGURY, is the continual desire to make Water, accompanied with an extraordinary Pain and Burning, caused by the sharp and pointed Particles that are in the Blood, or the Serous part of it. But the Cause of Bloody Urin, and of all other Bloody Fluxes, is the solution of any continuous Parts, caused by sharp and pointed Particles, pricking and cutting the Parts. And therefore the Remedies most proper for this Disease, are such as precipitate these acid Particles, or imbibe them, as likewise Anodynous Medicaments and Opiates.

DIABETES is a most swift and copious evacuating of the Liquor we drink by Urin, sometimes with little or no change made in it, accompanied with extream Thirst and a Wasting of the whole Body. For in this Disease the Contexture of the Blood is too loose, and the Pores of the Kidneys are too open, and the præcipitating Salt does too much abound. Some think the Drink goes directly by some short Passages from the Stomach to the Kidneys. Others, that it runs through the Pores of the Stomach and Guts into the hollow of the Belly, where meeting with the Bladder, it enters its pores, and thus is evacuated soon after, without any, or with but little change. In this Distemper adstringent and absorbent Medicines are commended, especially joyned with Opiates, to imbibe that vicious Salt, which precipitates the Blood too much.

The

XXXVIII.
The Scurvy.

XXXIX.
The Stone.

XL.
Strangury.

XLI.
Diabetes.





XLII.
The Gout.

The **GOUT** is a pain of the Joints, or parts about the Joints, caused by the various Corner'd Figures of Salts, or Saline particles, which twitch and prick the Fibres belonging to them. For when uneven and Saline particles do abound in the Blood, they by their Ruggedness and Points hurt the Fibres of the Nerves; or the Saline particles, by their sharpness twitching and vellicating them, are the Cause of those exquisite Pains, which those that are troubled with the Gout do endure; and other like Humours, impregnated with much the same Particles, flowing to the Parts already afflicted, do increase the Pain, which is often accompanied with a swelling and light Inflammation. For the Cure of this Disease, ponderous things are made use of, as Crabs-Eyes, Coral, Chalybeats, Mercurius Dulcis, as likewise Sudorifics, Topicks, &c.

XLIII.
The French-Pox.

The Disease commonly called the **FRENCH-POX**, is a Distemper of all the Humours of the Body, consisting in a Volatile Corrosive Acidity, disturbing all the Actions of it, and at last quite corroding it. For the sharp saline Particles that lye lurking in the Blood and Humours, do produce all the Symptoms that are obvious in this Disease. And therefore in order to the altering and blunting of these Particles, the Decoctions of Woods and Roots, and Mercurial Medicins are prescribed; and for the evacuating of them out of the Body, Preparations that cause Salivation are made use of, and particularly Mercurius Dulcis.

XLIV.
Ague or Fever.

An **AGUE**, or Fever, is an Effervescence of the Blood in the Heart, sometimes exceeding that which is Natural, and at other times less; but ever with greater Malignity. For when the Febrile matter or humour, endued with a Fermentative quality, doth from its Focus or Seat, be it Mesentery, or any other part of the Body, in which it hath been a long time a gathering, come into the Veins, and is mingled with the Blood, and with it carried to the Heart, it stirs up an Ague. For when it is thus communicated to the Blood, passing through the Heart, the Matter of the First Element, which is a great Enemy to our Blood, doth greatly shake it, and confound the parts and mixture of it, in which Confusion the Nature of an Ague and Fever doth consist. Yet it is not every thing that mingles with the Blood, doth presently produce an Ague; but such Matter only as is of a Fermentative Nature, that is, which disturbs the Mixture of the Blood. For this Fermentative Matter may be compared with Green-wood that is laid upon the Fire; for as such Wood, when once it begins to burn, doth burn more vehemently than Dry-wood; so the said Humour becomes more heated and dilated, than the Blood it self in its Natural condition. Hence therefore we conclude, that a **Quartan Ague** is produced, when the Matter, which is the Cause of it, stands in need of the space of 3 Days for its Concoction, before it can be fit to be united to the rest of the Blood; a **Tertian Ague**, when 2 Days is enough for this purpose; a **Quotidian**, when it is concocted every day, and mingles with the Blood; and **Continual**, with Exacerbations or Fits, when the Corrupt Matter doth so much infect the Blood, that it cannot rid it self of those defilements from that time, that the last drop of that Humour is run out, and that wherein the first drop of that which is gather'd anew begins to enter the Heart. For this being the time wherein

this depraved Humour, and ready to raise an Effervescence, is in greater quantity conveyed to the Heart, it must of necessity cause a greater Heat and Ebullition. Wherefore to the end that this Febrile Ferment may be expell'd in Agues, and more particularly in Quotidians, Vomits and Purges are used, which being exhibited at the Beginning, before the Fits, are found to be very successful in the Cure of them. But if the Ague be of long continuance, and the Stomach swollen, it is best to abstain from Vomits, and instead thereof to give gentle Purges; because Vomits weaken the Stomach. As for Fevers, they are commonly Cured by Remedies that precipitate and imbibe sour Humours, as Crabs-Eyes, Antimony Diaphoretick; by such as thin the Blood, and make it more fluid, as Barly-water, Whey, &c. by such as open Obstructions, as Carduus Benedictus, Camphire, Venice-Treacle, Volatile Salts and Spirits. All Bitter things are also employed with good success, both in Fevers and Agues, because they strengthen the Stomach, and keep out the Enemy; so that according to the Report of Physicians, Agues have frequently been Cured, only be exhibiting the Compound Essence of Wormwood.

CHAP. XXIV.

Of Medicaments in General, and of their Operations.

HAVING treated of the Diseases that afflict the Body of Man, it remains now that we add something concerning Medicins. Now a Medicament in general is that which being applied to the Body of a Sick person, is able by its virtue, to reduce it from a Præternatural state, to a Natural.

Some Medicins are Simple, as Roots, Barks, Leaves, Flowers, Fruits, Seeds, Gums, Juices, Animals and their Excrements, Products of the Sea, Salts, Stones, Minerals and Metals: Other are Compound; and these again are either Internal, which by the Mouth are taken into the Body: And these again are either Preparatory, otherwise called Digestive, which prepare and digest peccant Humours, in order to their Expulsion, as Syrups and Conerves; or Purgative, which evacuate the Matter that hath been prepared and ripened by the fore-going Digestives, as Purging Electuaries, Pills, and those the Latins call Linctus, and the Arabians Lobocho; or Cordial and Corroborative, which are used to strengthen the Body after Purgation, or rather when the Violence and Continuance of the Disease hath greatly weakened it; as likewise to remove any Obstructions or Distemperature in the Bowels or Humours of the Body; and take away the Symptoms of the Disease (as Pain, Watching, Lowness, Swooning,) such as are Cordial Confections, Powders, Treches. External Medicaments, are those that are outwardly applied to that part of the Body which is chiefly affected, and therefore are called Topicks, because they are applied to the place grieved; such are Oils, Ointments, Cerecloaths, and Plaisters.

But to leave the more particular Disquisition into these Matters to Physicians, I shall only in a few words speak something of the Common Medicaments,

I.
What a Medicament is.II.
Of the several sorts of Medicaments.III.
Of Medicins Common and Specifick.

IV.
Vomits or
Vomitory
Medicins.

caments, viz. Vomits, Purges, Diureticks, Sudorifics or Diaphoreticks, Cordials or Alexipharmacicks and Opiates; and then pass to Specifics, and briefly declare the Nature of them in general, and the manner of their Operation.

VOMITS are Medicins that evacuate the Stomach, and drive out peccant humours upwards, and that by drinking luke-warm Water, but more readily if some Oil or melted Butter be mingled with it, which will make the Stomach the more to loath it, and therefore the more easily to discharge it. Besides these common things, several Chymical Preparations are made use of to this purpose, as Salt of Virriol, Glass of Antimony, Flowers of Antimony, Crocus Metallorum, Sulphur of Antimony, Mercurius Vitæ, the particles of all which Preparations, when dissolved, do so violently twitch and affect the Fibres of the Stomach, as to cause a Convulsive Motion both of that and the Neighbour Parts, viz. the Gut called Duodenum, the Porus Choledochus, or Passage that conveys the Gall, and the Ductus or Vessel of the Pancreas, by which Convulsive motion whatsoever is contained in them is carried up to the Stomach, and from thence to the Mouth; and not only so, but by these Vomits the serous part of the Blood is often drawn out of the Extremities of the Arteries, carried up to the Stomach, and thence evacuated by the Mouth.

V.
Purging
Medicins.

PURGING MEDICINS are such as move and loosen the Belly, and drive out the peccant Humours in the Body of Man by Stool, such as are Roses, Violets, Cassia, Manna, Aloes, Rhubarb, besides manifold compound Purgatives. The reason of the operation of these Catharticks is, because they painfully affect the Spirits that are in the Fibres of the inward parts of the Body, and provoke them to excretory contractions; and moreover raise a Fermentation in the Humours, and thereby produce several fusions and separations of their parts. For tho' Manna and Cassia and other such like Gentle Purgers, which consist of very subtil parts, do not at all, or very little disturb the Stomach; yet as soon as they are past the Pylorus, or outlet of the Stomach into the Guts, they begin to irritate and twitch the most sensible Membran of the Gut Duodenum, and before they get any further, almost spend their whole force there. And because by the twitching and vellication of this Membran, the Porus Biliaris or passage of the Gall is considerably shaken, therefore they produce Bilious dejections.

VI.
Purging
Medicins
do not act
Electively.

The opinion of old was, that Catharticks purged Humours Electively, that is, by choice, as evacuating one Humour rather than another: They were induced to be of this Opinion, because they often found that the Excrements evacuated by purging Medicins, were of a Yellowish, and sometimes of a Blackish Colour, whence they concluded, that some Catharticks, purged Choler, and others Melancholy, as it were choosing and separating them from the rest of the Humours. But this is nobetter than an error; for tho' there be purgative Medicins that evacuate Choler, Phlegm, Melancholy and Watry Humours, which gave occasion to Physicians to distinguish Catharticks into Cholagogues, Phlegmagogues, Melanagogues and Hydragogues; as for Example, Rhubarb and Scammony, purge Choler rather than Phlegm; whereas Mercu-

rius Dulcis, and the Troches Albandal, evacuate Phlegm rather than other Humours. Yet is not this so to be understood, as if Scammony, for instance, purged Choler only, without touching any other Humours; or Mercurius Dulcis only expelled Phlegm; for it is certain that it purgeth other Humours also, tho' not so copiously as that of Phlegm; and therefore some Purgative Medicins may well be called purgers of Choler, and other Phlegm, &c. for tho' they do not purge that Humour only, whence they take their denomination, yet they do purge that Humour more copiously and signally than any other.

DIURETICKS are Medicins that purge by Urin, such as are the Roots of Smallage, Parsly, Radish, Bitter Almonds, Spirit of Salt and of Nitre, Juice of Limons and of Sorrel, White-wine, Renish-wine and Cyder; which when taken into the Body, do precipitate the mass of Blood, and separate the Wheyish part from it, which soon after is evacuated. For the particles of these Diuretick Medicins by their pointedness and thinness penetrate the Vessels, and by diluting, inciding and dissolving the Blood, cause a great quantity of Wheyish Matter to be separated from it in the Reins, and to be thence evacuated by the Ureters.

VII.
Diureticks.

SUDORIFICKS are Medicaments that provoke Sweat, such as are the Leaves, Roots or Seeds of Carduus Benedictus, Contrayerva, Angelica, or the like, being taken either in Powder, Decoction, Conserve or Magistery. The reason of their Operation is, because they consist of such particles as are very friendly to the Stomach and Guts, and therefore do not produce any Convulsions or Excretory Motions in them; only the mass of Blood being by them Rarefied and Heated, and consequently more swiftly circulated, do put the Body into a Sweat. Moreover, the particles of these Diaphoreticks entering the Vessels which are implanted in the Stomach, mix themselves with the Blood, and raising a Fermentation in it, make it run more swiftly through the Veins to the Heart, and there entering with some impetuosity, encreaseth the Beating or Pulse of it, by which means the whole mass of Blood, being rarefied and enkindled, rusheth more swiftly through the Arteries to all the outward parts, which not being able to admit it, nor the Veins to send it all back to the Heart, a considerable part of the serum of the Blood is evacuated through the Pores by Sweat.

VIII.
Sudorifics
or Diapho-
reticks.

CORDIAL MEDICINS are such as are proper to restore and kindle the interrupted or weakened Fermentations of the Blood in the Heart. Wherefore these Remedies are not called Cardiaca or Cordials, because they are appropriated to strengthen and comfort the Heart, as are all things that are Spirituous and Volatil, such as Saffron, Wine, especially to those who are not accustomed to the drinking of it, and Strong Waters. The reason of which operation is because their Volatil Particles entering the Blood, separate all Heterogeneous and Malignant Particles from it. Neither is the Passage from the Stomach to the Blood so long, that there should be need to fear that the virtue of these Medicaments would be lost by the way. For it is evident that the inward Nervous Coat of the Stomach is all interwoven with multi-
tudes

IX.
Cordials.

tudes of *Veins* and *Arteries*, so that *Medicaments*, not only *Purgative*, but any others may exert their operations upon the *Blood*, before ever they pass out of the *Stomach*.

X.
Opiats.

OPIATS are those *Medicines* which have *Opium* for their *Basis* or chief ingredient, and are proper for the laying of *Noxious Vapours*, and asswaging of *Grievous Symptoms*, for the strengthening of the inward parts, the removing of *Pain*, and recruiting of the *Animal Spirits*. The manner of their performing these effects is this, the particles of these *Medicines* do put a stop to the outgoing or efflux of the *Animal Spirits* and suppress them; so that during the operation of the *Opium*, they do flow much more sparingly to the inwards and other parts of the *Body*. And accordingly the *Pulse* of the *Heart*, and *Respiration* are diminished in their swiftness and force, and sometimes cause a difficulty of *Breathing*, and a weakness of the *Pulse*, with a listlessness to move, and drowsiness over the whole *Body*.

XI.
Why the Author treats of Specificks.

Next after the common *Medicins* follow **SPECIFICKS**, whose *Virtues* discovered by Experience, are consistent with the *Principles* of our *Philosophy*, and may be perpicuously unfolded by them. Some *Galenists* indeed have altogether rejected *Specificks*, probably because they found themselves unable to explicate the manner of their operation.

XII.
What a Specifick is.

The word *Specifick* is by *Physicians* used in a threefold Sense; for some call that a *Specifick Medicin*, which is peculiarly friendly to some particular part of the *Body*, as to the *Heart*, *Liver*, *Brain*, &c. Others call that a *Specifick Medicin*, which by a peculiar Quality doth evacuate some determinate *Humour*, as *Rhubarb* and *Cassia* are said to Evacuate *Choler*; *Senna*, *Melancholy*; *Jalap* and *Diagridium*, *Serofities* and *Pblegm*. But more frequently that is called a *Specifick Medicin*, which peculiarly cures some particular *Disease*, as the *Pleurisie*, *Tissick*, *Colick*, *Dropsie*, and in this Sense I take it here.

XIII.
Whether there be any Specifick Medicins.

It may therefore be enquired, whether there be any such *Specifick Medicins*. Some *Dogmatical Physicians*, leaning too much upon the *Principles* of the *Scholastick Philosophy*, will admit of no *Medicinal Virtues* that cannot be reduced to their manifest *Qualities*: But *GALEN* somewhere complains of these Men, that they either plainly deny matter of *Fact*, or else assign such causes to these effects as are not sufficient to explain them. So that not only *Galen*, but many other Learned *Physicians*, both Modern and Ancient, do maintain that there are *Specifick Medicins*.

XIV.
The effects of Specificks may be explained Mechanically.

It may also be queried, whether the effect of *Specificks* are *mechanically* explicable, that is, whether they be consistent with the *Principles* of *mechanical Philosophy*; to which I answer, that the *Principles* of the said *Philosophy* are of such a vast comprehension, that he who considers it, will not at all question, but that the effects of these *Medicins* may be explained in such a manner, as shall not in the least contradict the said *Principles*.

XV.
In order to the explaining of the Effects of Specificks, the

To make out this we are to observe, that the *Animated Body of Man* is not to be considered as a meer *Statue*, as if it were nothing else but a dead heap of several parts and matters whereof it consists; for to speak the truth, it is a most wonder-

ful and curious *Machin* or *Engin*, composed of fixt, liquid and spirituous *Substances*, with such exquisite *Artifice* joined together, that frequently we cannot judge so well concerning the action of an *Agent* that acts upon it, from the *Power* and forces of the *Agent*, considered in it self, as by the effects proceeding from it, because of the mutual action of the parts of this *Living Machin* upon each other.

It is likewise to be observed from the learned *Mr. BOYLE*, that it is not necessary that the *Operations* of all *Specificks*, or of the same in differing *Diseases*, must be of one kind; but differing *Specificks* may operate in several manners. And of these general ways he has proposed such as follow, premising only, that the *Specifick Remedy* do's not commonly, tho' sometimes it may, relieve the *Patient* by this or that single way of *Operation*, but by a Concurrence of two or more, that as it were join their forces to produce the desired effect.

Specifick Medicins may sometimes cure by dissolving or resolving the *Morbifick matter*, and thereby making it fit for expulsion by the greater *Common Shores* of the *Body*, and the *Pores* of the *Skin*. For it is most notorious, that a great many *Diseases*, and those very obstinate and *Chronical*, are caused by some rough and slimy *Humours*, which obstruct the *Passages*, and so hinder the *Circulation* of the *Blood*, and the free motion of other useful *liquors*; which peccant *Humours* are sometimes so exceeding *Glewy* and *Ropy*, that they will not give way to common *Remedies*. Whereas the *Specifick*, by the minuteness of its *Parts*, and the congruity of their *Figure* with the *Pores* of *Morbifick Matter* may be able to penetrate and resolve it, with the concurrent heat of the *Patients Body*, and thereby dispose for an evacuation by *Urin*, *Sweat* or other wise, as Nature finds most convenient. So that the *Blood*, or some other *Liquor* of the *Body* being impregnated with the amicable and *Active Particles* of the *Matter*, may be a *Menstruum* to dissolve the peccant matter; even as common *Water* impregnated with *Salt Armoniack* becomes a *Menstruum*, which by degrees will dissolve *Copper* and *Iron*.

Sometime a *Specifick Medicin* may mortifie the too over *Acid*, or other immoderate *Particles* that infect the mass of *Blood*, and destroy their *Coagulatory* or other *Effects*. For seeing that most *Distempers* do arise from *Acids*, and their *Malignant Effects*, it is very probable that all such *Diseases* may be cured, or much alleviated by such a *Remedy* as abounds with *particles* proper to mortifie the said *Acid Juices*. Which *Mortification* may be effected these two manner of ways: for there are some *Bodies* which destroy *Acids* by a *Positive Hostility*, that is to say, by such a contrariety as is discernible by the *Taste*, and by a conspicuous fight or conflict they maintain with the *Acid Juice*: Of this kind are all fixed *Alkalies*, viz. the *Lixivous Salts* of *Plants*, and all volatil *Alkalies*, as *Spirits* of *Harts-horn*, *Salt Armoniack*, &c. Another way whereby *Acids* may be mortified or dulled is, when their *Particles* are, as it were, sheathed or blunted; for as a *Knife* may be disabled to cut, either by filing or otherwise blunting its *Edge*, or else by covering the *Blade* with a *Sheath* fit for it; so an *Acid Compound* may lose

M m m m

make or structure of Mans Body is to be noted.

XVI.
Another thing to be noted about the operation of Specificks.

XVII.
The first way or manner whereby Specificks perform their Effects.

XVIII.
The second way or manner.

its power of cutting or pricking, when an *Alkal.* alters its *Figure*, or when its sharp *particles* are as it were, sheathed in the *Pores* of some other *Body*, tho' it may be the said *Body* may be wholly without *Taste*, or any considerable manifest quality by which it might appear contrary to the *sour Juice* it enervates, as a *File* is contrary to the *Edge* of a *Knife*.

XIX.
The third
manner.

A *Specifick Medicin* may sometimes help the *Patient* by precipitating peccant Matter out of the *Blood*, or other *Humours* of the *Body*. Thus *SENNERTUS* seems to intimate that in some cases the *Disease* is vanquish'd by a precipitation of the *Aguish Matter*. And *KERGE-RUS* in his *Treatise of Fermentation*, Sect. 3. Cap. 3. tells us in plain terms, that he had cured above 1000 persons of *Agues* without *Blood* letting, *Purging*, *Diaphoreticks*, *Diureticks*, altering *Medicins* or *Topicks*, only by means of one precipitating *Medicin*. Neither need we to fear any danger in these precipitations by the *particles* of the *Medicin* entering into, and spoiling the *Temperament* of the *Blood*; because it is certain that *Heterogeneous Matters* in the *Blood* may be precipitated by means of *Remedies* which never enter the *Blood*: For *Physicians* often exhibit filings of *Steel*, and other preparations of that *Metal*, to mortifie the *Acidities* of the *Blood*, and yet we have no reason to believe that the said metalline *particles* ever enter the *Blood*.

XX.
The fourth
manner.

Sometimes *Specifick Remedies* exert their effect by a peculiar corroborating of the *Heart*, and by that means, or without it, the *Parts* affected. For seeing that the *Heart*, *Brain*, *Liver*, *Kidneys* are all of them of a peculiar make and structure, and so likewise the liquid parts, as the *Gall*, the *Blood* and the *Lympha*; it may happen that the *particles* of a *Remedy* dissolved in the *Stomach*, and carried up and down the *Body* in the *Vehicle* of some of its *Liquors*, may according to their determinate *Figure*, *Size*, *Stiffness*, *Flexibility* or *Motion*, &c. be more fit to be admitted in some one part of the *Body*, as the *Brain*, *Heart*, &c. than another, and so by continuing in the *Pores* thereof, and associating themselves to the *Fibres*, or furnishing it with some *particles* it wants, may strengthen the *Tone* of that *Part*, and enable it to resist the action of the *Morbifick* matter, and expel it.

XXI
The fifth
manner.

Sometimes a *Specifick Medicin* may exert its operation, by producing such a *Disposition* in the *Mass* of *Blood*, as may enable *Nature* by correcting, expelling, or other fit ways, to overcome the *Morbifick* matter, or other cause of the *Distemper*. For seeing that as most of the *Diseases* incident to *Mans Body*, are produced by a vitiated constitution of the *Blood*, so the recovery of it to *Health* and *Soundness* depends on the restoring of it to its former state; a *Specifick Medicament* may divers ways effect this advantageous change of the *Blood*. As *First*, by furnishing the *Blood* with some very active *particles*, by which means it will not be necessary for the *Medicament* to raise any *Fermentation* in it. *Secondly*, A *Specifick* may be of great use in restoring the *Mass* of *Blood* to a laudable state, by dilating and attenuating or thinning of it. For when the *Blood* is too thick, as frequently it is, it cannot so freely pass through the *Capillary Vessels*, whence an obstruction will follow in them, whereby the *Circulation* of the *Blood*

will be retarded, and great inconveniencies accrue to the *Body*. And on the other hand, if the *Blood* be too thin, especially if it be overmuch agitated, it will easily run out of the *Vessels*, and produce various *Fluxes* of *Blood*, and other dangerous effects, that commonly accompany the extravasation of the *Blood*. Now a *Specifick Medicin* may correct this vitious consistence of the *Blood*, by furnishing it with such *Particles*, which by their *Figure*, *Bulk*, *Motion*, &c. may subdue those vitious *particles* that thicken the *Blood*, and attenuate them; or by dividing the *parts* of it dispose it to a greater degree of *Fluidity*. And when the *Blood* is too thin, which is the effect sometimes of *Diseases*, and sometimes of certain *Medicaments*, and more particularly of *Aloes*, a *Specifick* in this case may afford such *particles*, as by their easy complication and infolding one another, may curb the too active *particles* of the *Blood*, which do too much attenuate it, or it may assist the expulsion of the said *particles* by *transpiration*, or any other way. *Thirdly*, a *Specifick* may be helpful to restore the *Mass* of *Blood* to its former good state, by some particular operation it may exert upon the *Heart*, by strengthening the *Tone* and *Vigor* of it, so as that it may be able to transmit the *Blood* to the greater advantage and welfare of the *Microcosm*.

XXII
The sixth
manner.

Sometimes also a *Specifick* may unite its *particles* with those of the *Peccant Matter*, and with them constitute a *Neutral Matter*, that may be easily, or is not needful to be expelled. As when the *Blood* being impregnated with an *Acid Juice*, hath lodged the same in some stable part of the *Body*, as in the *Liver*, *Spleen* or *Kidneys*, &c. In this case the *particles* of the *Specifick* may without any sensible contest or effervescence, when manifest *Acids* are mortified by such like *Alkalies*, so combine themselves with the *particles* of the vicious *Acidum*, as to make one compound with them, which differing from the *particles* of the *sour Juice* in *Motion*, *Figure*, *Solidity* and *Stiffness*, or in one or more of the same, must needs constitute a *substance* of a *Different Nature* from the said *Acid particles* before that they were corrected.

It was noted before, that when it was said that a *Specifick* doth cure a *Disease*, it is not to be understood as if a *Specifick Remedy*, or *Nature* by means of it, did for the most part cure *Distempers* by one only of the propounded *Modes*, seeing that two, or more of them may concur to produce this effect. Besides, I have only here undertaken to explain the operation of *Specificks* in General; but never asserted that the *ways* and *modes* by me propos'd, to be true and genuine, but only propounded them as so many probable ways whereby *Specificks* may produce their effects. Wherefore these things are not *Dogmatically* asserted by me, but only delivered by me as *Possible* or *Probable Explications*, my chief design being only to evince thereby, that the *Operations* of *Specificks* are congruous to the *Principles* of *Mechanical Philosophy*.

XXIII
An Advancement
concerning
Specificks.

There is an *Objection* the *Rejecters* of *Specifick Remedies* usually urge against them, which is, that by being taken into the *Stomach* and *entrails*, they are greatly changed by *Digestion*, and mixture with the *Aliments*, a good part of them sent away

XXIV
An Objection
on against
Specifick
Medicines
answered.

away by *Excrement*; and that as soon as they are got out of the *Stomach*, they pass through manifold *Strainers* of different *Textures*, which in all probability stop the greater part of the *Medicinal Particles*. But this *Difficulty* will disappear, if we consider that *Rhubarb* tingeth the *Urine* of those that have taken it, many hours after, with a *Yellow Colour*. That *Elaterium* eaten by a *Goat*, communicates a *purging* quality to its *Milk*, so as to *purge* a *Child* that takes of it. For the *particles* of some *Bodies* do very obstinately retain their *Figures*, and do not easily quit their *virtue*. For if a *Medicament* exerts its activity by impregnating the *Blood*, or any other *Liquor* in the *Body*, thereby turning it into a kind of *Menstruum*, it may so happen that the several *Strainers* through which the *Particles* are to pass, may stop the less fit parts of the *Vehicle*, so as to make the *Menstruum* more appropriate to the overcoming of the *Peccant Humour*, or that at least thereby it may be so changed as to restore this *Substance* in the *Body* of a *Man* rather than another. And tho' there may but a small quantity of the *Medicinal Matter* reach to the part, on which it is to act, yet ought not we to question the effect upon that account, seeing that the efficacy of *Natural Agents* upon the *Body* of *Man* is not to be measured by their *Bulk* or *Quantity*, but by their *Activity* and *Subtlety*.

XXV. An *Objection* may be also made against what hath been here asserted concerning the *Operation* of *Medicaments*, that all *Topical Medicines*, especially such as are applied to the *Wrists*, *Amulets*, and things hung about the *Neck*, or only outwardly touching any other part of the *Body*, cannot afford sufficient *Medicinal Particles* for correcting of the *Peccant Matter*, or subduing of the *Disease*. For an Answer to this *Objection*, it will be sufficient to consider that the *Skin* of *Mans Body*

is very full of *Pores*, by which the more *subtil particles* of the *Remedy* may enter; as is evident from manifold instances. *Water* penetrates the *Pores* of the *Bladder*, and dissolves the *Salt* of *Tartar* or *Sugar* contained in it. *Quick-silver* mixed with *Ointments*, and outwardly applied, insinuates it self through the *Pores* of the *Skin*, into the most inward parts of the *Body*, where it often produceth most violent operations. Neither can it be difficult to conceive how the *particles* of any *Specifick* being once got into the *Pores*, may further diffuse themselves throughout the *Body*, forasmuch as near the *Cuticle* or thin outward *Skin* of the *Body* there be many *Capillary Vessels*, which tho' very small, yet have their *Cavities* continuous with other greater *Vessels*, and it will be easily understood that the *particles* of the *Medicament*, being once entred into these *Capillary Vessels*, will by the *Vehicle* of the *Liquors* contained in them, be transmitted to the *Branches* of the *Principal Veins*, and so by means of *Circulation* be mingled with the whole mass of *Blood*, and with it conveyed to all parts of the *Body*.

The only difficulty that remains now to be removed, is whether there be any *Medicaments* that are appropriate to this or the other particular part of the *Body*? To which I Answer, that there is no impossibility nor improbability in it, that the *Particles* of a *Specifick Medicament* should be destined more to one part of the *Body* than to another, so as not only to strengthen it, and preserve its sound Constitution, but to restore it to its former strength and vigor, when weakened by any *Disease* or *Distemper*: Forasmuch as by their particular *Texture*, *Motion*, &c. they may in a peculiar manner prepare the *Molesting Matter* for *Expulsion*, and withall so work upon the *Fibres* of the *Part* affected, as both to *Enable* it, and *Excite* it to free its self from its *Enemy*.

XXVI.
Whether there be any Medicaments appropriated to any particular part of the Body.

The

The Ninth Part

OF THE INSTITUTION OF PHILOSOPHY.

OF M A N,

Considered in the other P A R T,

The M I N D.

CHAP. I.

*Of the Nature of Human Mind, and that
it is more Evidently perceived than
Body.*

I.
That too
much Cre-
dit is not
to be given
to our fal-
lacious
Senses.

II.
The Exi-
stence of
Human

SINCE we have often been deceived by our *Senses*, and the *Images* of *things* have been impos'd upon us, which differed from the *Objects* whence they proceeded, or whence we *imagined* they proceeded; and since in our *Dreams* we have seem'd to behold some things, which nevertheless were far enough off from us; and to hear *things* which in no wise smote the *Organs* of our *Hearing*: We have hereupon sufficient *Cause* to suspect that *Corporeal things* are not always such as we apprehend them to be, and consequently that we have sufficient *reason* to doubt of their *Existence*, forasmuch as *Natural Reason* dictates to us, that we are not to trust those *things* which have at some time or other deceiv'd us. Wherefore we may doubt whether there be a *Heaven*, *Sun*, or *Stars*; whether those *Bodies* which are about us are *real*; whether we have *Body*, *Feet*, or *Arms*, in regard we have oftentimes in our *Dreams* seem'd to make use of them, whereas at the same time, deep *Sleep* hath bound us fast, and rendred us immovable.

But though we may doubt of the verity of *Corporeal Things*, yet we cannot doubt but that we have an *Existence*, so long as it is certain we *doubt*;

for it is impossible that any one should *doubt* or *think*, and at the same time not be. Whence this Proposition, *I think therefore I am*, is the first certain *Conclusion* we can possibly make, when we muster up our *thoughts* in Order; whence it is inferred, that our *Mind* is more *known* to us than our *Body*, in regard whatever doubt we make of other *things*, we cannot but Be so long as we *Doubt*.

For if I attentively weigh and examin who *I am*, who *write* these *things*, who *see*, who *hold* the *Pen*, who draw the *Lines*; I know for certain, that were the use of my *Hands* taken away, my *Eyes* digg'd out, and my *Fingers* cut off, I could neither *write*, *see* nor *touch*; but nevertheless should find it apparent that I yet *Exist*; and suppose I were depriv'd of all *Exterior Senses*, yet still *I am*, so long as I *think*: For my *Body* may be dissevered into divers *parts*, and none of those *parts* be remaining with which I am encompass'd, since I am not all *Heart*, nor *Brain*, nor *Liver*, nor any other of those *parts* which constitute the *Body*; yet nevertheless something of me may be remaining, which makes use of those *parts*, and with which it is surrounded as with a *Garment*.

The *Existence* of *Human Mind* being thus explain'd, we are now to inspect what it is, or rather, who that *I* is, who have a clear conception, that *I am*, and do doubt of the *Existence* of others. For am I any *thing*? surely *I am*. What then, I am a *Thinking*, *Knowing*, *Imagining*, *Perceiving*, *Willing*, *Affirming*, *Denying Thing*; for I know that I *Perceive*, I imagine that I *Behold* many things, I am sensible that

Mind is in-
fer'd from
hence, That
we are.

III.
The Soul is
not any
thing be-
longing to
the Body.

IV.
What it is
to think.



G. Freeman Sculp.

J. Kip Sculp.

To the Worship -
of Ickworth in the
This Plate is humbly



-full John Hervey
County of Suffolke Esq.
Dedicated by Rich. Blome



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that many *things* are conveyed from their *Objects* to my *Senses*, I affirm that I am a *Thinking thing*, I deny that *Corporeal things* do certainly *Exist*, and am conscious to my self of them all; but I am more certain that I am, since it may come to pass, that all those *things* of which I *Think*, may be no where *Existent*; but it cannot be otherwise, but that I must needs be, who appear to *Behold*, to *Affirm*, to *Deny*, to *Will*, &c.

V.
A Definition of Human Mind.

Human Mind therefore may rightly be defined a *Thing thinking by a certain peculiar way*, finite, and as it were, by mutual Covenant joyned to a *Body well disposed*. And herein it differs from an *Angel*, or *Spiritual intelligence*, which is indeed apt to assume a *Body*; but not so firmly inclining to it, as to *desire*, as the *Human Mind* doth, to have it intimately united.

VI.
Why a Thinking thing is said to be finite.

But it is called *Finite*, because tho' a *Human Mind* always *Thinks*, yet it *Thinks* not of all *things*, nor penetrates immediately into those *things* of which it *Thinks*. Moreover it *Wills* many *things* which it attains not to, all which are *Arguments* of imperfection, from which the *infinite Mind*, that is to say, *God Almighty* is absolutely free.

VII.
What is to be understood by the name of Cogitation.

By the name of *Thought* is understood that interior *Sense* and *Conscience* by which we are certain of all those *things*, which we *Act* or *Suffer*; so that to say that *Human Mind* is a *Thinking substance*, is no other thing than to say, that there is in it a *Conscience*, or *Co-discerning* of all *Cogitations*, *Wills*, *Appetites* and *Sensations* which are found therein; whether it be their *Principle*, or *suffers* from others: For certain it is, that whatsoever is in us which depends not upon the *Cogitations* of the said *Mind*, belongs not to it. Whence the simple *Cogitation* of *Human Mind* may aptly be defined to be, an *implanted Action* of *Human Mind*: Whereof the said *Mind* by its own testimony is conscious. In the first place, *Cogitation* is said to be something *implanted* in the *Mind*, because it is indeed the very *Essence* of the *Mind*. Secondly, It is said to be by its own testimony conscious, in regard every *Mind* hath its own *Cogitation* so known, that tho' there should be a doubt concerning other *things*, yet the *Cogitation*, it self can never be called into doubt; since the *doubting*, may the very *Erring person* must of necessity *Think*.

VIII.
The Soul Thinks even in Sleep.

Some difficulty may haply arise from the foregoing definition of the *Mind*, as if *Human Mind* be a *Thinking substance*, that is, *Willing*, *Nilling*, *Doubting*, *Perceiving*, &c. it should always *Think*, which seems a thing impossible to any one that is *asleep*, since then we cannot be conscious that we do *Think*. To this I answer, that nothing occurs to us in *Sleep*, which directly or indirectly proceeds from the *Soul*, whereof we are not conscious; and tho' our *Soul* in the midst of *Sleep* may *Think*, but negligently, yet it is not to be thought totally destitute of all *Cogitation*: By the same reason almost as when it is said, that there is no part of the *World* which is at any time totally void of all *Motion*, tho' some parts may be said to *Rest*, by reason of the more slow and insensible *Motion*, and may seem as it were deprived of all *Motion*.

IX.
Why we remember not our Cogitations.

It may haply be urged, if this were true, we could not but remember at least some of those *Cogitations*, but we daily experience the contrary. I

answer: It is one thing to be conscious of our *Thoughts*, and another thing to remember them; for there is more required to the remembrance of any thing, than to the being conscious thereof; for to remember a thing so long as the *Mind* is joyned to the *Body*, it is requisite that the *Species* or *Image* thereof should have its *Vestigia* or *Foot-steps* in our *Brain*, upon which we afterwards reflecting should remember; but to *Think*, it is sufficient that we are conscious of our *Perception* or *Cogitation*, which happens not only to persons *Sleeping*, but even to *Infants* in the *Mothers Womb*. Since doubtless those very *Infants* have many *Cogitations*, and their *Minds* taken up with *Idea's* of *Heat*, *Cold*, *Tuillation*, *Pain*, &c. which proceed from the Union of the said *Mind* with the *Body*; however they remember not afterwards what they *Thought*, or *suffered* at that time.

If it be alledged that it is sufficient for *Human Mind* to be called *Cogitant*, for that it hath the power to *Think*, and not for that it always actually *Thinks*: As a *Potter* hath a faculty always of forming *Pots*, *Pitchers*, &c. yet nevertheless for want of *Clay*, or the *Potters Wheel*, cannot always reduce his *Power* into *Act*; so it suffices, that there be implanted in the *Mind* a *Power* to *Think*, tho' it do not always actually exercise that *Power* for want of *Matter* which should occur, or through the defect of *Organs* which are hinder'd in *Sleep*.

The Answer is easie; for there is no necessity that the *Potter* should always actually *Operate*, by reason he *Acts ad extra*, or *Externally*, and requires *External Matter* for those things he is to form; but *Human Soul* in its *Operations* wants no *Object* to tend unto: For if all things which are to finite the *Senses* of the *Body* were removed, it would yet have the *Idea* of it self, and of all those *Verities* which we term *Nota per se*, or known of themselves, and consequently *Human Mind* cannot but always *Think*; and certainly it seems to imply a contradiction, that that *Spiritual Part* of ours, so long as it hath an *Existence*, should not *Think*, since it is no other than a *Thinking thing*, and we can conceive nothing in it besides *Cogitation* or *Thought*.

For the difference between *Matter* and *Soul* is, that that is the *Potentia* or *Power*, this the *Act*; so that *Cogitation* must needs be always present in every *Intellectual thing*, but *actual motion* is not always requisite in *Body* or *Matter*, in regard its Nature is *Sluggish* and *Idle*, that it comprehends *Potentiality* or *Power*, and not *Act*; but for a *Soul* to be without *Act* or *Cogitation* implies a *Contradiction*, since if you take away *Cogitation* from it, there will remain nothing in it of positive and absolute, by which it may be said to *Exist*.

I know that some will object, that *Human Mind* may be without all *Cogitation*; but this we absolutely deny: For if it should so happen, it would either so happen, because it hath not a *Power* or *Faculty* of *thinking*, or because it will not have such a *Faculty* or *Power*. If it hath not such a power, its *Essence* is destroy'd, in regard it consists in *Cogitation*; but if it will not, that very thing is an inference that it doth *think*, since to *Will* and *Nill* are *Modes* of *perceiving*; for we undergo no greater difficulty in conceiving that the *Soul* must needs always *think*, than in conceiving the *Light* must needs always *Shine*; and that *Heat*

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X.
Whether the Power of Thinking sufficeth for the Mind to be called Cogitant.

XI.
The Answer.

XII.
Soul is opposed to Body as Act to Power.

XIII.
Human Mind cannot be without Cogitation.

not but be always *Hot*, for as much as it belongs to the *Essence* of the *Soul* to *Think*, as it belongs to *Light* to *Shine*, and *Heat* to *Warm* or make *Hot*; for a Faculty supposes something real, and *Existing* in *Nature*; or if we well attend to our *Conception*, it is no other than a thing really mutable and capable of divers *Modes*; So that as the faculty of receiving *Figures* in the *Body*, is meer *Extension*, so the faculty of *Thinking* in the *Mind* is meer *Cogitation*, so far as it may be applied to divers *things*, and by divers *ways*.

XIV. To think is no less Essential to Human Mind, than to be Extended is to the Body.

Moreover the *Actual Cogitation* of the *Soul* may be proved by comparing it to the *Body*; for as it cannot be granted to be a *Body* which is not extended; that is, which hath not an *actual* and *determinate Figure*; In like manner *Human Mind* must of necessity have some *Cogitation*, which in a manner is its *Life*; but that *Children* and *Infants* in the *Mother's Womb*, should not afterwards remember their *Cogitations* in that *State*, need not be any matter of wonder, since in *Persons* of more adult *Age*, there may possibly sometimes remain no memory, not only of *things* which were represented in *Sleep*, but also even of those *things* which have been acted or thought on *Waking*.

XV. Cogitation is either taken for the thing Thinking, or for the Modes of Thinking.

It will yet more clearly appear, that *Cogitation* belongs to the nature of *Human Mind*, if *Cogitation* be in a twofold acceptation considered, first as it is that which constitutes the *Nature* of an *immaterial thing*, and then it is no other than that *thing* which *Thinks*; in another sense *Cogitation* may be taken for divers *Modes* of *Thinking*, in as much as *Substance* is capable of *Exciting* divers *Cogitations*, for the *Thinking Nature* hath power from it self to draw forth such or such *Acts*; nevertheless it is not thence to be infer'd, that a *Thinking Substance* is something universal, containing all the *Modes* of *Perceiving*: No more than it can be said, that a *Body* is something common containing all *Figure*; because *Cogitation* is not a *Universal*, but a particular *Nature* which admits all those *Modes*, as *Extension* is a *Nature* receiving all *Figures*; for we may very well conceive a *Cogitant Nature*, tho' all its *Modes* are not known, yet they cannot be understood without the said *Cogitant Nature*. For if I *Imagin*, if I *Will*, if I *Remember*, *Cogitation* appears in all these *things*; yet on the contrary, if I *think*, there is no necessity that there should be any one of these in particular, and consequently *Imagination*, *Remembrance*, *Volition* are only divers *Modes* of *Thinking*, even as *Figure*, *Motion*, *Site*, &c. are divers *Modes* of *Extension*, or of a *thing Extended*.

XVI. Mind is Cogitant as Matter is Extense.

Wherefore we must conclude, that the *Essence* of *Mind* is placed in *Cogitation* in the same manner, as the *Essence* of *Matter* consists in *Extension*, and according to the various *Modifications* of *Cogitation*, *Mind* is always *Willing*, *Imaginant* or *Sentient*; in like manner, as according to divers *Modifications* of *Extension*, *Matter* assumes the *Form* sometimes of *Water*, sometimes of *Fire*, sometimes of *Fewel*, or infinite other particular *Forms*; and consequently as a piece of *Wax* may be changed into divers *Figures*, and be *Round* or *Square*, not without varying its *Nature*; so *Human Mind* remains one and unvaried, although it may be altered divers *ways*, and may be mutable by a different *Application* of it self to *Heaven*,

for example sake, *Earth*, *God*, *Angels*, &c. because tho' it be limited and finite, yet it is not determined to any thing certain, and consequently *Thinks* or perceives all *things* which are deeply inherent in it.

I have heretofore in several places said enough to shew, that the *Soul* or *Mind* is a certain substantial *Form*, when as all other *Forms* are nothing else but certain rangings and dispositions of *Parts*. Nor must I now omit to declare openly, and in most express *Terms*, that it is that which *individuates* a *Human Body*, or rather *Man* himself, and does principally and essentially make one to differ from another. For as the whole *Essence* of a *Human Body* in general, consists in a certain *disposition* to receive a *Human Soul*; and the particular *Essence* of each *Body*, as for instance the *Body* of *Peter*, is founded in a particular *disposition* it hath to receive its own proper *Soul*; supposing that in some part or portion of *Matter*, should be found the same essential *disposition*, which that *Body* had wherewith *Peter* was Born, it cannot be otherwise, but that it must be a *Human Body*, even the *Body* of *Peter* himself, and the very same in number wherewith he was Born; forasmuch as it hath the same essential *Form*, or principle of *Individuation*: And also if the same *Soul*, to wit *Peters*, were actually united thereto, it is necessary for the same reason that there must be a *Man*, yea, *Peter*, and the same numerical *Peter* that was before.

CHAP. II.

That Human Mind is distinguished from the Body, and is Spiritual and Immaterial.

I. THAT the Immateriality of Human Mind may the more clearly be discerned, it will not be from the purpose to explain more at large the *Essence* of *Mind* and *Body*, and shew wherein they may be exactly distinguished.

They who have most deeply searcht into the *Nature* of *things*, have observ'd among the *Attributes*, which constitute the *Essence* of any *thing*, that there is one *primary Attribute*, which in a manner gives a *being* to it, and from whence all the rest flow as from a *Fountain*: As *Cogitation* in respect of *Human Mind*, for as much as all *things* which are found in it presuppose *Cogitation*; for *Imagination*, *Volition* or *Will*, *Sensation*, &c. are only different *Modes* of *Cogitation*, which spring from it, as from its *Root*: For to *Imagin* is another *Mode* of *Thinking*, than to *Will*; and to *Will*, another *Mode* of *Thinking* than *sensation*. In like manner *Extension* is the first *Attribute*, which constitutes a *Corporeal thing*, and from which all the rest are derived, for as much as all *things* which attend it, presuppose *Extension*; for whatsoever hath *Figure* is *Extense*, whatsoever can be divided is *Extense*, and whatsoever is contained in place is *Extense*; so that *Cogitation* and *Extension* constitute the *Natures* of *Intelligent* and *Corporeal Substance*.

III. If any one urge, that there are *Idea's* granted which involve *Cogitation* and *Extension* together; for Example, the *Idea* of *Pain*, *Colour*, &c. for whosoever is sensible of *Colour*, *Pain* and other *Idea's* of the *Senses*, or does but imagin them, *Exten-*

XVII. The Soul or Mind is the cause of individuation in the whole Man.

I. The Mind is to be distinguished from Body.

II. In every thing a principal Attribute is given from whence other things proceed.

III. An Object is from the confused Idea of a thing Extense and a thing Cogitant.

Extension must needs occur to him with such a *Perception*. Who is able to perceive *Whiteness*, or any other *Colour*, without *Extension*? Wherefore if *Idea's* be granted, which are compounded of *Cogitation* and *Extension*; what hinders, but that we may judge that there is in the thing it self somewhat like to that *Idea*; that is to say, that *Cogitant* and *Extense* may be in the said Thing at the same time?

IV.
Composition
takes not
away Di-
stinction of
Parts.

I Answer, that by this Argument *Cogitation* is not concluded to be one in *Reality* and *Essence*, with *Extension*, but only in *Composition*. So that *Cogitation* and *Extension*, or a *thinking* and *extended Substance*, constitute one *Compound*, so far as there are found therein divers Modifications of *Cogitation* and *Extension*; which together, and in one act are attain'd by the *Senses*, and also by *Imagination*. And in Truth, if the Matter be narrowly weighed, it will appear that those *Idea's* of *Senses* and *Imagination*, in which *Extension* is joyn'd with *Perception*, afford us no other Notion, than that *Cogitation* and *Extension* have an *Existence* together, or that we are compos'd of *Mind* and *Body*. So that these two things are no ways oppos'd to each other; to wit, that the Judgment concerning these things, follow the *Idea's* which we perceive by *sense*, and is conformable to them; and yet the Nature of a thing *Thinking*, is altogether distinct from the Nature of a thing *Extended*.

V.
Mind dif-
fers more
from Body,
than from
Nothing.

For the *Idea* of the *Mind*, hath nothing common with the *Idea* of the *Body*, and one of them may be clearly and distinctly conceiv'd without the other. Nay, so great is the difference between *Cogitation* and *Extension*, that *Cogitation* may more properly be said to be *Nothing*, than *Extended*; because tho' in respect of *Substance* generally so taken, *Mind* differs not more from *Body*, than from *Nothing*, since both of them is something subsistent, and wants not the help of another *Substance* to *Exist*; yet if they be consider'd in themselves, so far as one of them is *Extense*, and the other *Cogitant*, they are more distinguish'd from each other, than from *Nothing*; in regard every *Creature*, being not a most perfect *Entity*, but including many *Imperfections*, participates of *Nothing*. But it can be no way apprehended, that the *Idea* of *Cogitation* should include any thing of the *Idea* of *Extension*, and consequently *Cogitation* disagrees or differs more from *Extension*, than from *Nothing*. In the same manner as *Vertue* is more properly distinguish'd from *Vice*, than from *Stupidity*: And *Science* is more remote from *Error*, than from *Ignorance*.

VI.
It is prov'd
that the
Soul is Im-
material.

This distinction being well understood, it will be no difficult thing to make out, that the *Mind* is a *Spirit*, or some *Immaterial Entity*; because since *Mind* and *Body* are Subjects of different Proprieties, the *Conceptions* which we have of them, are also absolutely different. For the diversity of *Essences* is known to us by their Proprieties. Nor have we any other Indication whereby to judge, that the *Natures* of things are different, than by inspecting into the distinction of Proprieties in them. For we have no other way to make observation, that *Ice* and *Fire* differ from each other; but because *Fire* heats, and *Ice* cools; or that the *Eye* is a thing different from the *Foot*; but because we see with our *Eyes*, and distinguish divers *Objects*,

and with our *Feet* we walk and sustain our *Body*. Since therefore *Human Mind* and *Body* have altogether different Proprieties, no *Man* can doubt, but that there is an absolute distinction between them; and I dare say, there are no *Attributes* which are more opposite one to another, than to *Think* and to be *Extended*. For to be *Corporeal*, and to *Know*, what relation have they one to the other? What Similitude can be apprehended between *Perception* and *Motion*? or between *Will* and *Figure*? Whence it is plainly to be asserted, that *Mind* and *Body* are altogether different; and consequently since *Body* hath *Extension*, the Thing *thinking* must needs be void of all *Extension*; which is the same thing as to be *Immaterial*: For by the Name of an *Immaterial Entity* nothing else is to be understood, but that which hath no parts, and is void of *Extension*.

If it be Objected, that diversity of *Conceptions* does not always infer a difference in things; so as that they must be incompatible in the same Subject. For the *Conception* we have of *Justice* is undoubtedly distinct from that we have of *Mercy* in *GOD*; and yet no *Divine* can deny, but that they are both equally fit to be ascrib'd to *GOD* himself; therefore it follows not, because the *Conception* of the Thing *thinking*, is distinguish'd from the *Conception* of the Thing *Extended*; but that they may be attributed to one and the same Subject.

VII.
An Objec-
tion drawn
from the
distinction
of Justice
and Mercy
in God

I Answer, When two things may be conceiv'd incompletely, or by abstraction of the *Intellect* inadequately conceiving the Matter, there is no necessity that they be repos'd in divers Subjects; but those may well be which are consider'd adequately, or as *Compleat Entities*: For *Justice* and *Mercy* in *GOD* are consider'd not as two *Compleat Things*, since *Justice* may be understood without a *Just Person*; but not *Mercy* without a *Merciful Person*: And consequently since they cannot be but modally distinguish'd, they may be both in *One GOD*. But we completely understand, that a *Body* or *material Substance* is *Extense*, *Partible*, *Figurate*, with an Exclusion of all those things which are peculiar to the *Mind*: And on the contrary we understand, that the *Mind* is a *compleat Substance*, which *Perceives*, *Wills*, *Doubts*, &c. tho' those things be remote from it which belong to the Nature of *Body*; and so *Cogitation* and *Extension* are incompatible in the same Subject.

VIII.
An Answer
to the Ob-
jection.

Other Objections which may be made against the Incompatibility of *Cogitation* and *Extension*, are resolv'd in the same manner, as if any should say, that *motion* and *figure*, and the like *modes* of a thing *Extended*, have divers *Conceptions*, and yet are found in the same Subject. For *figure* and *motion* cannot be conceived, but in *Extended matter*; For as *motion* is a *Body* having *figure*, so we cannot understand *figure*, but in Matter apt for *motion*. There is a great difference between *Motion* and *Figure*, and between a thing *extended* and *cogitant*; for should all Moveable be taken away, we should have no longer any *Idea* of *Figure* or *Motion* remaining, since such is the Reason of *Modes*, that altho' *Substances* may be conceived without *Modes*, yet *Modes* cannot without *Substances*; therefore in regard we might conceive a thing *Cogitant*, tho' there were no such thing as *Body* in

IX.
A thing
Cogitant,
and a
thing Ex-
tense, are
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than Fi-
gure and
Motion
in the
same Sub-
ject.

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X.
The Spirituality of the Soul is demonstrated by its Operations.

rerum Natura; it follows, that a thing *Cogitant* is really distinguish'd from a *Subject Extense*, and consequently is *Material* and *Spiritual*.

The same Conclusion may also be demonstrated *a posteriori*, to wit, by its *Operations*, which are *Spiritual*, and absolutely Independent of all *Matter*: For *Volition* and *Intellect* include no *Extension*, since we conceive both very well, without any mention made of *Matter*. Besides, we find by daily Experience, that the *Cogitations* of *Man* are render'd the more obscure, by how much the more he hath of commerce with the *Body*; and on the contrary, more subtil and distinct, by how much the more he subtracts himself from the *Body*, as is manifest in *Extasie* and *Rapture*, where the *Mind* in a manner abstracted Meditates altogether on what is *sublime*, and distinctly sees all things; all which would never happen, if the *Soul* were *Material*. For if the *Power*, for Examples sake, of *Understanding*, depended upon the *Body*, it would of necessity follow its *Dispositions*, that is, be depress'd when that is weakned, and become more vivacious, when that is vigorous and strong. Whereas we find by Experience the contrary thereof in *Old men*, who apprehend things more clearly and distinctly than *Young men*, who at the same time excell *Old men* in *Strength* of *Body*, and have their *Animal Spirits* more vivacious, upon which *Corporeal motions* depend.

XI.
The Apprehension of Spiritual things, shews the Mind to be Incorporeal.

Then how can it be, if *Human Mind* be *Material* and *Corporeal*, that it should contain in it self such vast *Images* of things? How should it comprehend the *Latitude* of the *Earth*, the *Immensity* of the *Heavens*, and the *Bodies* that are diffus'd through all parts of the *Universe*, if it be not *Spiritual*? How can it discern a *Line* to be altogether void of *Latitude*? A *Point* not discernable to the *Eye*, and wholly *Individual*? Wherefore we must in this Matter conclude with the Words of St. AUGUSTINE, *If Corporeal things are beheld with Corporeal Eyes, by a certain wonderful Affinity, it certainly follows that the Mind, by which we see Incorporeal things, is not Corporeal or Body*.

XII.
The Cognition of Verity, &c. argues the Immateriality of the Soul.

Moreover, who knows not how many and how great things totally separate from all *Matter* our *Soul* can conceive? For without any help of the *Senses*, it apprehends *Verity*, *Sapience*, *Unity*, *Beauty*; it understands the *Principles* of *Sciences*, and unfolds the *Demonstrations* drawn from them, and attends to the *Series* of *Reasons*; but with what *Sense*, or with what *Corporeal Species* doth it represent these things to it self? Wherefore since by *Reason* alone it performs all these things, it must of necessity be *Immaterial* and *Incorporeal*. Lastly, Many things which are divided in themselves, meet together in our *Mind*, as *opposite* and *contradictory Propositions*, &c. yet nevertheless the *Soul* is not increas'd by the reception, nor by the withdrawing of them. A thing which cannot happen to *Body*, which always become greater by the addition of *Parts*, and lesser by the abstraction of them.

CHAP. III.

How Human Mind is United to the Body.

I.
Three Notions

Here are Three principal *Notions* which commonly offer themselves to us: The No-

tion of *Body*, which we have maintain'd, consists in *Extension*, from whence the *Idea's* of *Figure* and *Motion* proceed: The *Notion* of *Mind*, whose *Essence* we place in *Cogitation*, and to which the perceptions of *Intellect*, and propensions of *Will* do tend: The third *Notion* is of *Soul* and *Body*, as they are united; from which *Union* we understand, that *Mind* hath the force of moving *Body*, and on the contrary, the *Body* hath the power of *Acting* upon the *Mind*, as shall hereafter be more clearly made out: For it is not to be imagin'd, that the *Soul* is only present with the *Body*, as a *Mariner* is present in his *Ship*, or as a *Rider* is seated upon his *Horse*; but that it is intimately united to it, so as to make one Compound with it: I say, the *Notion* of *Soul* and *Body*; because the *Soul* is properly so called, inasmuch as it is destin'd to *Inform* the *Body*, or inasmuch as it can be United to a well-disposed *Body*, as hath been formerly mention'd.

For the *Soul* of *Man* is not to be consider'd as a *Spirit* in it self, and as it is *Absolute* and a *Substance* which *Thinks*; but according to the *Relation* which a *Spirit* hath to a *Body* well dispos'd, and to which it is United. For Experience plainly teacheth us, That all the *Functions* of the *Soul*, consider'd in *Quality* of a *Soul*, depend absolutely on the *Body*, to which it is United, and which renders this *Union* altogether necessary.

The only difficulty is to apprehend this sort of *Union*: For our *Intellect* can hardly conceive, how *Body*, which is a thing *Extense*, moves the *Mind*; and *Mind*, which is a thing *Immaterial* and *Inextense*, can impel the *Body*; and tho' by Experience we find it is so, yet no Comparison or Discourse drawn from other things is sufficient to demonstrate and evidence it to us. Those *Philosophers* who admit *Real Accidents*, and judge that they are *Entities* distinct from *Substance*, produce a Similitude of a *Stone* tending downward, by the force of *Gravity*. Now since, according to these *Philosophers*, this *Quality* of *Grave things* tending downwards, is not *Substance*, but *Accident*, this may serve for a sufficient *Explication*, how a thing not *Extended*, may act upon a *Body* *Extended*.

Yet because we maintain, that there is no such *Quality* in *Nature* granted, another way is to be found out; but before we fix upon a *Mode*, by which the *Body* is annex'd to the *Soul*, it will be worth our while to note, that all the difficulty in conceiving that *Union*, arises chiefly from our selves; who following the *Prejudices* of our *Infancy* first, and afterwards the trite *Opinions* of *Philosophy* in *Schools*, have thought it impossible for *Human Intellect* to conceive, how a thing *Material* and *Incorporeal* can be United, and how a thing *Unextended* can be associated to a thing *Extense*, unless that be taken also for *Extense*. This *Prejudice* hath exercis'd the *Wits* of many; and because they could find no *Mode* of *Union*, by which things so distant in *Nature* could be United, were compelled to have recourse to certain *Virtual parts*; and to assert, that the *Soul* is not indeed really, but only *virtually* *Extense*, and that it hath *Virtual parts*, by means whereof it may the better be adjoyn'd to the *Body*, and so compose one *Total* with it.

But

which usually presents themselves to us.

II.
Human Mind is to be consider'd, as United to the Body.

III.
It is difficult to conceive, how the Soul is United to the Body.

IV.
To this difficulty the Prejudices of Infancy, and the Opinions of a School conduce.

V.
It cannot
be said,
that the
Soul is
virtually
Extense.

But what they mean by these *Virtual parts*, I confess I do not in the least understand, nor doth any *Notion* of them present it self to me. Nor can it be conceived, that there are things *Virtually Extense*, unless thereby are understood *parts* without *parts*, that is, whereof one is placed beyond the other. But *parts* situate one beyond the other, are distinguish'd not *virtually*, but *really*, and may separately *Exist*, and consequently may be said to be really distinguish'd; since in the Conception of them *Division* is included, and a Separation of them one from another, which presuppose *Extension*.

VI.
Three sorts
of Union.

But that the Conjunction of *Mind* and *Body*, which is commonly call'd *Union* may be the better understood, we are to premise what *Union* is, and how many kinds of it there are. *Union* is a *Con-fociation of things agreeable into One*. And since we can have a *Conception* but of two things, namely *Mind* and *Body*, we can thence infer only a *Threefold Union*: The first, which inter-cedes between two *Bodies*; the second, by which two *Minds* are associated; the third and last, by which *Mind* and *Body* are United. But all *Union* includes some *Similitude* and *Dependency*, in which respect 2 different things pass after a certain manner into one. For in this very respect they are judged to be United, when they can *act* and suffer dependently upon each other: For 2 *Bodies* are said to be United, when they are so near, that one may *act* upon the other; and that again suffer from the former. Not that it is necessary, that both together *act* and suffer at once; but it is sufficient, if one *act* and the other suffer. In the same manner 2 *Minds* are united one with another, when the same *Affections* are common to them both, and are so dispos'd, that neither of them *wills* or *loves* any thing, but for the others sake. In the same manner we say, that a *Rational Soul* is joyn'd to the *Body*, when any *Operations* of the *Body* depend upon the *Cogitations* of the *Mind*; and on the contrary, that the *Body* is joyn'd to the *Soul*, when any *Cogitations* arise dependently from these *Operations*, or rather *motions* of the said *Body*.

VII.
How Mind
and Body
are United.

Nor do I think, that any one will deny this manner of *Conjunction* or *Union*, by which the *Mind* and *Body* are conjoyned, since a clearer cannot be made out; in regard the *Mind* and *Body* operating dependently upon each other, we may very easily understand the *Similitude* and *Relation*, which ought to be among things which are united; and this *Similitude* and *Relation* we have formerly affirm'd to consist in *Action* and *Passion*: So that as the *Union* of 2 *Minds* will continue so long as *Love* remains between them; so the *Union* of 2 *Bodies* will never cease, so long as they are locally present one with another. In like manner the *Union* of *Mind* and *Body* will not be dissolv'd, so long as he who hath joyn'd them together shall suffer the *Body* to produce its *motions*, with a dependency upon the *Cogitations* of the *Mind*, and the *Mind* to Exercise its *Cogitations* dependently upon the *motions* of the *Body*.

VIII.
The Con-junction
of the
Mind with
the Body,
is twofold.

By Two ways most especially may *Spirit* be joyn'd with *Body*; first into one *Person*; as the *Word* was made *Flesh*, S. John I. Secondly, Into One *Nature*; as *Human Mind* is joyn'd with *Body*. Of the first, *Divines* treat in their *Theses*, con-

cerning the *Incarnation* of the *Word*; the second is handled by *Philosophers*.

The *Union* of *Soul* and *Body* consists in an *Actual* dependency of all the *Cogitations* of the *Soul*, upon certain *motions* of the *Body*; and of some certain *motions* of the *Body*, upon some *Cogitations* of the *Soul*; I said in the first place, That this *Union* consists in an *Actual* dependence; because for the *Uniting* of *Body* and *Soul*, it suffices not that their *Motions* and *Cogitations*, can mutually depend upon each other; but it is also necessary, that they *Actually* depend. In the second place, I said; and of some certain *motions* of the *Body*, upon some *Cogitations* of the *Mind*; because not all the *motions* of the *Body* depend upon the *Cogitations* of the *Mind*, since many depend upon the *Machin* of the *Body* only, and the *Universal Laws* of *Nature*.

Others explicate this *Commerce* another way; for they will have it, that a certain *Mode* inter-cedes between *Body* and *Mind*, to which they give the Name of *Union*, and account it instead of a *Ligament* or *Bond*, by which those things that make up the *Compound* are joyn'd one with another. For they cannot conceive how 2 Things can be joyn'd together, and nothing of *New* happen upon this *Conjunction*. But they have enough to be satisfied: For if by the Name of *Union*, they understand nothing, but that mutual *Commerce* of *Actions* and *Passions*, which is found in *Mind* and *Body*, they agree with us; for we acknowledge that *Union* is the *Mode* of the Being of *Body* and *Soul*: For all things are after another *mode* or *state* when United, than when Separated. But if they mean, that this *Union* is some real thing distinct from both, and as it were that very thing, by the *mediation* whereof the *parts* of a *Compound* are United, we apprehend not, nor acknowledge any such thing in *Philosophy*; and should we receive it, we can no way make it out, how such a thing can joyn together two such, as *Mind* and *Body*. For this *Union* should be either *Extense*, or void of all *Extension*: If they affirm it *Extense*, how can it be Co-extended with *Mind*, which is a *Spirit* and *Immaterial*? If it be void of *Extension*, how can it be joyn'd to a *Body*? So that this *Mode* of *Uniting* is altogether superfluous, since the difficulty of *Conceiving* how 2 *Substances* can be immediately United one with another, by a mutual dependence of their *Motions* and *Cogitations* is less, than to comprehend, how they should be united by another thing, which if it be *In-extense*, cannot be conjoyn'd to the *Body*; nor to *Mind*, if it have *Extension*, and be divided according to *parts*.

And the *Truth* is, since neither *Body* can *Think*, nor *Mind* be capable of *Dimension*; there can be no *Mode* common to *Mind* and *Body*, except a mutual *Acting* of each upon each, from which alone the *Proprieties* of both can follow.

Perhaps it may be said. That the *Conjunction* of *Mind* and *Body* cannot consist in the relation which the *Actions* and *Passions* of both have to each other; because such a *Concourse* presupposes, that the *Mind* is already United to the *Body*. For the *Mind* must first be in the *Body*, before it can draw forth any *Operations* which depend upon the *Body*, and consequently *Union* precedes that *mutual* dependency.

O o o o

IX.
Wherein
consists the
Union of
Soul and
Body.

X.
There is
not requir'd
any Union,
as a thing
distinct
from Mind
and Body.

XI.
But a Re-ciprocation
of Action
and Passion.

XII.
Whether
the Soul
and Body be
United to
each other,
before they
mutually
Act and
Suffer.

XIII.
The Answer.

I Answer, That there is no Necessity that the Mind should be first United to the Body, before it operate there, in regard its *Existence* precedes not *Action* in Time: So that it does not absolutely require to be joyned to the Body, before such time as it draws forth its *Operations*. Nay, if the Matter were well Examined, when as *Spirit* is confin'd to no Space, and may only be in a place by its *Operations*: It cannot therefore be said, to be in the Body, but because it exercises there its *Operations* or *Cogitations* dependently on the Body. Which mutual Correspondence constitutes the Reason of the Union, which is between the Mind and Body.

XIV.
When the Union between Mind and Body begins.

But if it be ask'd, How comes about this *Conjunction* of Soul and Body, and when doth it begin?

I Answer again, It is most Consistent to Reason, to believe that this Union begins at that very moment in which the Body gives occasion to the Mind, to draw forth some *Cogitation*, and Contrarily the Soul to the Body, to stir up some *motion*. For as this *Conjunction* is plac'd in a mutual *Dependency*, which is between both, in respect of certain *Actions* and *Passions*, it cannot begin sooner: So that it is most probable, that such a Union begins, as soon as the Heart, Brain, Nerves, Muscles, &c. are sufficiently fram'd to bring it about, that the *Action* of the *Objects* may be transmitted as far as the *Glandula* and the *Animal Spirits* be convey'd into the *Muscles*. On the contrary, this Union ceaseth, whenever it happens that the said Commerce cannot be continued, or when any part of the Body is so defective, that the Heart is no longer able to transfuse the *Spirits* to the Brain; nor the Brain into its *Muscles*, to agitate some, and conserve others in their proper state: So that the said Confederacy is never broken on the part of the Mind, but of the Body.

XV.
This Union is Essential to Man.

From these things we deduce, that the *Conjunction* of Soul and Body, though it be call'd an *Accident* of either part, so far as it may be present or absent, without the destruction of either part, is nevertheless so proper to both Parts of Man together, that it may and ought to be allow'd to be *Essential* to him: For *Essence*, as it is deriv'd from *Esse*, to be, is so called, because so long as it is something, it must of necessity be. So that so long as Man is, it follows, that the foresaid Efficacy of Mind upon Body, and of Body upon Mind, must needs be.

XVI.
Why GOD may not be said to be joyn'd to his Creatures, or an Angel to an assumed Body.

But it is also easie to Understand, why GOD, tho' he is present to all *Created things*, as who Conserves the same by a Continued *Creation*; yet nevertheless is not said to be conjoyned to them, in regard they cannot act upon GOD, by exciting in him those *Cogitations* which he had not before. So also an *Angel*, who according to the *Vulgar Opinion*, is present personally in an assumed Body, cannot be said to be joyned to the said Body. For tho' an *Angel* may act upon such a Body, yet that Body cannot Re-act upon the *Angel*; So as that when the said Body, for Examples sake, is hurt, the *Angel* should feel pain, as we find by Experience in our selves.

XVII.
Conditions of the Union of Body and Soul.

But as there is no Society, which is not founded upon some Conditions, which are Reciprocal between one and the other party, united or associated

together: GOD, in the formation of Man, united Body and Spirit upon these Conditions.

The First is, That as long as the Soul shall remain United to the Body, there will be an *Idea* of *Extension*, that is to say, of Body, consider'd in it self; and that it shall have this *Idea* from the *motion* of the Brain, excited by the general Course of the *Animal Spirits*; according to which condition, the Soul hath always present the *Idea* of *Extension*, as Experience teacheth us.

The Second is, That the whole *motion* of the Brain, which is excited by the Nerves, will produce within the Soul a certain *Sensation*, which will always accompany this *motion*, and the Soul not be able to separate it. By means of this Condition, we see, for Example, the Light, when the Sun moves the *Optick Nerves*: We hear Noise, when resounding Bodies shake the *Auditive Nerves*.

The Third, That the Spirit, so long as it remains United to the Body, will have the *Idea* of some particular Body, from the *motion* which this Body shall excite in the Brain, by the means of the *Organs of Sense*. By this Condition, the Soul hath the *Idea* of all Bodies, which smite the Senses.

The Fourth, That the whole *motion* of the Brain, which shall be excited by the determinate Course of the *Animal Spirits*, resembling another *motion*, caused by the Nerves, will produce in the Soul the *Idea* of some particular Body, which the Soul hath already perceiv'd. By this Condition it is, that there are represented to us things absent, which we have formerly seen.

The Fifth is, That by the *Sense of Touching* we feel pleasure or pain, according as the *movements*, which cause these *Sensations*, shall be conformable or in opposition to the Natural Constitution of the Body. By this Condition, the *motion* of a Feather drawn over the Hand, as it were for *Tuillation*, will cause a *Sentiment of pain* in Sick People, in regard the said *motion* is not agreeable to the present state of the Body. On the contrary, it excites a *Sentiment of pleasure* to those that are in health, because in that Estate it is conformable to the present Constitution of the Body.

The Sixth is, That when we have received the *Idea* of an *Object*, it will be attended by an Inclination of the Soul, which will carry it either to fly or to pursue the said *Object*, according as it shall appear good or bad. By this Condition it is that we are sensible of Love, Hatred, and generally all *Passions* that attend the Soul.

The Seventh is, That all the *Thoughts* of the Soul, which regard the preservation of the Body, as they create *Sentiments* and *Passions*, must be accompanied with that *motion* of the *Animal Spirits*, which shall be most proper for the Execution of the *Desires* of the Soul. And it is upon this Condition that Fear, for Example, is accompanied with a Course of *Animal Spirits*, which induceth us to shun what we fear; and that on the contrary, Desire is accompanied with a Course of *Spirits*, which carries us to the pursuit of that which we desire.

The Eighth is, That the Spirit, inasmuch as it is united with the Body, never Thinks, but by the motions of the Body, to which it is united. And it is by this Condition, that all the *Idea's* which we have

XVIII.
The First Condition.

XIX.
The Second.

XX.
The Third.

XXI.
The Fourth.

XXII.
The Fifth.

XXIII.
The Sixth.

XXIV.
The Seventh.

XXV.
The Eighth.

have of particular *Bodies*; depend mediately or immediately, upon some *motion* of the *Brain*. I say, *All the Idea's we have of particular Bodies*: And hereby we are to Note, that the *Idea's* which the *Spirit* hath of *GOD*, and of it *self*, depend not at all upon its *being* United with the *Body*; but simply upon its being a *Spirit*, whose whole *Nature* is to *Think*, and by consequence to *think* of *GOD* and of it *self*.

XXVI.
The Ninth.

The *Ninth* is, that when the *Animal Spirits* are more abounding than usual, they excite in the *Soul*, *Goodness* and *Liberality*; when their *Parts* are more strong and gross, they excite *Confidence* and *Hardiness*; when they are equal in *force*, in *grossness* and in *figure*, they procure *Constancy*; when they are more agitated, they produce *promptitude*, *diligence*, and *desire*. In fine, when they have a temperate *agitation*, they cause *tranquility* of *Spirit*. On the contrary, when these *Qualities* fail in the *Animal Spirits*, or when there is an opposite Temper in them, the effects that are produc'd in the *Soul*, are *Malignity*, *Timidity*, or *Fearfulness*; *Inconstancy*, *Tardiness*, *Inquietude*, &c.

XXVII.
The Tenth.

The *Tenth* and last Condition is, That the Union of *Spirit* and *Body* will continue so long as the *Heart* shall be in a condition to send *Blood* towards the *Brain*, and from thence to send the *Animal Spirits* through the *Nerves* into the *Muscles*, which are subservient to those *motions* that are necessary for *Life*. By this Condition it is, that the *Soul* never gives occasion to the *Body* to break the *Union*, it being sufficiently evident that the default always proceeds from the *Body*, as Experience teaches us.

CHAP. IV.

Whether there are Innate or Inbred Idea's in Human Mind.

I.
There are three sorts of Idea's.

IT is a frequent and common Disquisition in the *Schools*, whether *Human Mind* be pure *Potentia*, or *Power*, and so abstracted from the *Species* or *Idea* of things, as to have no inbred *Cogitations* in it. The *Aristotelians* maintain the *Affirmative*, and are of *Opinion*, that that Faculty of *Perception* which we experiment in our selves, is, when first the *Mind* begins to exist, as it were a *Rasa Tabula*, or plain *Table*: So that whatsoever *Idea*, in process of time, is deprehended in it, is drawn from the *Senses*, or acquir'd by *Tradition*. So that for the better Solution of this famous *Question*, we are first to know what an *Idea* is, and how many *Acceptations* it admits of. By the Name of *Idea*, nothing else is understood, but the thing it *self* thought, so far as it hath any thing *Objective* in the *Intellect*. Or more in short, *Whatsoever can be conversant in our Cogitation*: And there are Three kinds of it, namely, *Adventitious*; or those which are receiv'd from things transmitted by the *Senses*; as is that *Idea* which we have of the *Sun*, *Stars*, and the like *External Objects*. Secondly, *Fictitious*, or which are formed from our *Intellect*; as the *Idea's* we have of a *Chimera*, *Syrens*, &c. Lastly, *Innate*, which are Created with the Faculty of *Thinking* and forming them: And they are called *Innate*, in the same manner as we speak of the *Stone*, or the *Gout*, to

be Natural to some *Families*, of which *Families* they who are born, bring with them into the *World* a disposition prone to those *Diseases*.

These things thus briefly noted, we are next to enquire, Whether *Human Mind* be so Created, as to have these sort of inbred *Idea's* born with it, and not drawn from any of the *Senses*; and in Truth, it seems not to be deny'd, but that many such *Idea's* are found therein. For to begin from things most obvious, it is most certain, that the *Idea's* which we perceive by any *sense*, are inbred, and can no way proceed from the Things themselves by any *Similitude*. For he that well understands, by what way the perception of *Pain*, for Example, is excited in the *Soul*, will easily be convinc'd, that the *Idea* of *Pain* hath no more affinity with that perverse disposition of *Parts*, by whose means the *Soul* frames an *Idea* of *Pain*, than that deprav'd *Affection* hath an affinity with a *Sword*, by which a *Wound* hath been inflicted into a *Body*; or than the unwonted agitation of *Blood* or *Spirits*, by whose impulse *Human Mind* conceives *Idea's* of *Passions*, carries a *Similitude* with those *Images* or *Cogitations*; and consequently when the *Sense* of *Pain*, and other Perceptions which are produc'd by the *motions* of the *Spirits*, are excited in the *Minds* by no other *Species*, which have affinity with them, it must needs be affirm'd, that these sort of *Idea's* which have no affinity, are innate or inbred to it. For it is evident, that all the *Perceptions* of the *Senses* are obscure and confus'd, insomuch that *Light*, *Colours*, *Sounds*, *Odours*, *Sapours*, *Heat* and *Cold*, and other tactile *Qualities*, are not apprehended by us, but by a confus'd way, and not under the Conception of *Motion*: And hereupon we must conclude, that their *Idea's* are innate in us, and that it is from our *Nature* that we understand them.

This takes place not only in *Qualities*, whereof we acknowledge our *Cogitation* to be confus'd; but also in things most clear and manifest. For what can be more clear, than that when a *Line*, a *Triangle*, a *Rhombus*, or other *Mathematical Figures* are given, it is not to be attributed to our *Senses*, that we have the *Idea's* of them? Since most certain it is that there is no absolute true *Right Line* in *Nature*, nor any *Triangle* whose 3 *Angles* are perfectly Equal to two *Right Angles*. Since therefore the *Idea's* of *Figures* proceed not from the *Senses*, and contain nothing *Corporeal* or of *Corporeal Affection*, we must necessarily conclude, that they are implanted in *Human Mind*; that is, that a Faculty is given by *GOD* to the said *Mind*, to produce such like Forms of *Conceptions*, and that they are not form'd according to any Exemplar of things without.

If any one Object, That trite Saying of the *ARISTOTELIANS* in the *Schools*, viz. that there is nothing in the *Intellect*, which was not first in the *Senses*. I answer, that that *Vulgar Axiom* is altogether false, and only to be admitted by those who do not sufficiently consider by what *Motives* the *Soul* is excited to perceive *External things*. For whoever will seriously examin, how far our *Senses* extend themselves, and what it is precisely that can arrive from them to our Faculty of *Thinking*, must needs grant, that no *Idea's* of things are presented from them to us, such as we form them

II.
The Idea's of Qualities are Congenite or Equally born with the Soul it self.

III.
The Idea's of Mathematical Figures, are implanted into the Mind, from their first Original

IV.
It is a false Maxim, that there is nothing in the Intellect, which was not first in the Senses

them in our *thought*; so that there is nothing in our *Idea's* which was not first inbred in our *Mind* or *Cogitant Faculty*, excepting those *circumstances* which regard experience, so as to *judge*, that such or such *Idea's* as are now present to our *Cogitation*, are to be referred to things without us: not that the said *Idea's* have immitted those very things to our *Mind* through the *Organs* of our *Senses*, but because they have immitted something which gave it occasion to form those very things by a faculty innate to it, at one time rather than another; forasmuch as nothing hath access to our *Mind* from external *Objects*, through the *Organs* of our *Senses*, except certain *Corporeal Motions*; but neither those *Motions*, nor the *Figures* arising from them, are conceived by us, such as they are form'd in the *Organs* of the *Senses*; whence it follows that those very *Idea's* of *Motions* and *Figures* are inbred in us. And so much the more ought the *Idea's* of *Pain*, *Colours*, *Sounds*, and the like, to be innate, as our *Mind*, by means of certain *Corporeal Motions*, can exhibit them to us; since they have no similitude with *Corporeal Motions*.

V.
It is by Nature that we understand what is Thing, Substance and other general Axioms.

Besides, who can have the confidence to assert, that the *Idea's* we have of *Thing*, *Substance*, *Truth*, *Goodness*, *Equity*, and the like general Natures, have any commerce with *Material Things*, and that the *Idea's*, which we form of them, flow'd out of *Bodies*, through the *Senses*, into the *Mind*? Who will be so positive as to affirm that these *Common Notions*, for Examples sake, *The same thing cannot be and not be*; *that which is done cannot be undone*; *those things which agree in a third, agree among themselves*; *take equals from equals, and there remain equals*; and the like, proceed from the *Senses* and from *things* without us? What can be more absurd, than that all *common Notions*, which are in our *Mind*, arise from the said *Motions*, and cannot be without them? I would fain have any one tell me, what that *Corporeal Motion* should be, which can form any *common Notion* in our *Mind*; since all those *motions* are particular; but these *Notions* are universal, and have no affinity or relation to the said *motions*. Since therefore nothing can come into our *Mind* from *Bodies* but by *motion*; it is not to be doubted, but that those *Idea's*, at least, which have no affinity with *motion*; are *Congenite* and *Inbred* with the said *Mind*, from their *Original*. Hence St. *Augustin* in his 9th Book *de Trinitate*, *The Mind*, saith he, *knows it self by it self*; and in another place, *It is known for a certain, that the Mind can never be so affected, as not to remember, not to understand and love it self, though it should not be always thinking*.

VI.
The Idea of God is inbred in Human Mind.

The same thing also evidently appears in that *Idea* which *Human Mind* hath of the *Existence* of *G O D*; forasmuch as it forms the said *Idea*, not by the *Benefit* of the *Senses*; not by *Human Institution*; not by its own *Arbitrement*: And consequently it must needs be innate or inbred in it, since there is nothing else in *Nature* to be found, which can set forth an *Ens Infinite*, *Omnipotent*, *Immenfe*, *Supremely Good* and *Perfect*; for though there is in us, in regard we are *Substances*, an *Idea* of *Substance*; yet there occurs not to us from thence an *Idea* of a *Substance*, *Infinite*, *Independent* and *Supremely Intelligent*, &c. since we

are finite; and so, whatever *Idea* we have of *G O D*, must needs have it from a *Substance* which is *Infinite*, that is, *G O D*, and consequently which immediately proceeds from him.

If it be urg'd, that this *Idea* of *G O D* which we experiment in us, proceeds not from our faculty of *thinking*, to which it is innate, but from *Divine Revelation*, *Tradition* or *Observation* of things; for in an *Entity* supremely perfect, which is call'd *G O D*, *Human Mind* considers nothing but those *perfections* which are found in *Man*; for Examples sake, *Existence*, *Power*, *Justice*, *Mercy*, and the like: from which, if imperfection be removed, they may be so ascribed to *G O D*, the most Excellent of *Beings*.

This *Objection* is resolved by our most illustrious *Philosopher*, in his Answer to the fam'd *RE-GIUS*, *Physician* of *Utrecht*; by giving to understand, that one *thing* may be from another two ways; either because this other thing is the *proximate* and *primary Cause* thereof, or because it is *remote*, and only *accidental*, and so gives occasion to the *Primary Cause* to produce its effect at one time rather than another: As all *Artificers* and *Workmen* are the *primary* and *proximate Causes* of their own *Operations*; but they who set them on *work*, and pay them for their *labour*, are the *accidental* and *remote Causes* of the said *performances*, which perhaps, the *Workmen* unbidden, and without hopes of reward, would scarce have gone about. Now there is no doubt but *Tradition*, or the *Observation* of things is often times the *remote Cause* which inviteth us to give attention to that *Idea* which we are able to conceive of *G O D*; and to represent it to our *Cogitation*. But that it is the *proximate* and *efficient Cause* of the said *Idea*, cannot be asserted by any one, except by him who judges that nothing is ever understood by us concerning *G O D*, but what the name *DEUS* or *G O D* means, or what sort of *Corporeal Figure* it is, which is made use of by *Painters* to represent *G O D*. Forasmuch as *Observation*, if it be made by the *Sight*, represents nothing to the *Mind* by its own proper virtue, but *Pictures*, and those only consisting of certain *Corporeal Motions*; if by *hearing*, nothing but *Words* and *Voices*; if by other *Senses*, nothing is contain'd in the said *Observation* which can possibly relate to *G O D*: So that all those things we think of, except *Voices* and *Pictures*, as their *significates*, are represented to us by *Idea's*, not coming from elsewhere than from our faculty of *thinking*, and consequently inbred in us.

VII.
Whether an Idea of God can be had from the Observations of things.

VIII.
The Difficulty removed.

CHAP. V.

Of the Faculties of Human Mind, Intellect, Imagination, Will, Memory, Reminiscence and Wit.

SINCE there are found various *Operations* in the *Mind*, we must of necessity assign various *Principles* from whence they proceed; for diversity of *Actions* argues diversity of *Powers*. Wherefore since there are divers *Species* of *Cogitations* in the *Mind*, there are consequently to be established divers *faculties* which are the proprieties of a *thinking Being*. Forasmuch as by the word *Faculty*, nothing else is understood, in *Human Mind*,

I.
Diversity of Actions argues diversity of Powers.



To the Right Honourable
Botterwick, Earle of
to King James 4th Lord
Riding of Yorkshire, Vice
Northumberland, and
of the most noble order
Ma^{ty}. most Honourable
This Plate is humbly



John Sheffeld, Baron of
Mulgrave, L^d. Chamberlaine
Lieutenant of the East-
Admirall of Yorkshire
Bishoprick of Durham, K^t.
of the Garter, & one of his
Privy Councill &c^a.
Dedicated by Richard Blome.

Mind, but an Aptitude or Capacity to a certain Variation; for since *Mind* is Indefinitely Variable, Actual Variety must needs proceed from some Faculty, as from a present Cause. All Operations which carry Cogitation with them, are of two sorts. Of the first kind are those Operations which have Intellect for their Principle. Of the second are those which depend upon Will. And tho' many other modes of thinking may be reckoned, yet they all proceed from two faculties of Perceiving and Willing: For Sense, Imagination, Intellect, Memory, &c. are various modes of perceiving, whereas Judgment, Affirmation, Negation, and all our Appetites and Propensions are different modes of Willing. Of the Senses we have already discours'd; it remains that we say something of Intellect, Imagination, Will and Memory.

II. By the word Intellect, nothing else is to be understood, but that faculty by which the Mind, without any Material Species, apprehends all Objects whatsoever, whether Immaterial or Corporeal; and this faculty is more inseparable from the Mind than any of the rest; whereof there is not any one that hath not some dependence upon the Body; whereas the Mind hath no need of the help of any other thing to understand by, but it self and its own proper Ideas. So that the Mind hath no need of any Organs, nor makes any use of the Brain, whereby to Conceive or Understand External things.

III. Only in this one thing, Intellect is distinguish'd from Imagination, that is, that the Mind can Imagine nothing but Corporeal, when in Imagining it applies it self to the Body, and contemplates the Image of the Object as present to the Eye, which happens not in Intellection or understanding; when as the Mind, in Understanding, is in a sort recluded or shut up within its self; and if it apply it self to any External Body, it is only to contemplate the Idea of the Object which it hath in its self. Wherefore that common Saying, Nothing is in the Intellect, which was not first in the Sense, is not to be conceived of the pure faculty of Understanding. Since the pure Intellection, as we have said, as well of a Material as Immaterial Object, is independent of any Corporeal Species, and cannot any way be received in the Intellect; but may very well be understood of the Imagination, because we cannot possibly imagine any thing but what is Corporeal, particular and determinate. Whence the Power of Imagining in the Soul may be defin'd, The Power which the Soul hath to know particular Bodies, and the representations of Equality or Inequality which are in them. So that Intellect and Imagination differ in respect of the Object; since the Object of the Intellect is of larger extent than the Object of Imagination, as having a perception, not only of things which belong to Intelligences, and Substances meerly Spiritual; but also many other proprieties, or particular Bodies, which are not deprehended from the Senses, and which decline even Imagination it self, as hath been said in the foregoing Chapter.

IV. Whence we may conclude, that Intellect in general is nothing but a Faculty or Power which the Soul hath to know whatsoever it knows, by what way or manner soever it knows it.

The second sort of our Cogitations proceeds from the Will, that is, from a Power within us, to determin our Resolves, by giving or denying our Assent in things which are propounded by the Intellect. For such is the form in the ordering of our Cogitations, that the Light of our Understanding, always precedes the Actions of our Will; in regard the Intellect is, as it were, the Torch, without which our Will cannot determin any thing. When, I say, that Will cannot determin any thing, but what the Intellect shews it; it is not to be so taken, as if those two Powers were things distinct from each other, but that it is one and the same Mind which is diversly considered according as it Perceives or Wills, and according as it Suffers or Acts; so as that Knowledge, Pleasure and all other Faculties of the Soul, are but one and the same Soul, considered as having power to Know, to Will, to Imagine, to Perceive: For the Intellect is a passive Power, which consists in this, that it wholly receives Ideas; whereas the Will is a faculty by which the Mind chooses, or is determin'd to embrace or decline all that which the Intellect clearly perceives; so that the Will is nothing but the free determination of the Mind to do any thing, or not to do the said thing, to affirm or deny a thing to be such or such.

And consequently Will in general may be defin'd, a power which the Soul hath to determin and resolve about those things which it apprehends, which way soever it apprehends them.

For this is the Nature of Will, that at the same time wherein True or False, Good or Bad is, by the Intellect, propos'd to it clearly and without confusion, it resolves, without any hesitation, to choose the one and reject the other; so that the Essence of it consists not, as some will have it, in Indifference to choose any thing, or not to choose it, since Will can never be said to be indifferent, except when the Object is not clearly and distinctly propos'd to it, or when it knows not what it ought to resolve upon. For a Man is said to be indifferent, when few Reasons are propos'd to him, or such as are not sufficient to move him, to embrace one thing rather than another: whence it is said of a Sinner, that always some things are found indifferent in him; namely, a Sinner knows not clearly the Bad he is about to commit; or if he formerly knew it, he attends not, at the time he commits it, to the reasons which prove it to be bad; for if he perceiv'd it, it could not be that he should sin, according to that vulgar Axiom, The Will pursues no Evil as it is Evil.

On the contrary, when a man sees a thing clearly, and without all obscurity to be convenient for him, it is almost impossible but that he should be carried with an inclination to it, so long as the judgment of the self same thing remains in the same person. So that Will, infallibly tends toward that which appears most convenient for it, so it be made clear and manifest to him. Nor is there less reason why it should be called Free, since as DESCARTES saith, in his fourth Meditation, Neither is it necessary that I should be carried into both parts, to be free; but by how much the more I incline to one part, either because I perceive True and Good more evidently in that, or because GOD so inwardly disposes my thought, so much the more freely I choose

V. What Will is, and how it differs from Intellect.

VI. The definition of Will.

VII. The Essence of Will consists not in Indifference.

VIII. But in Determination.

choose that. Neither indeed doth *Divine Grace*, or *Natural Cognition* ever diminish Liberty, but rather increase and confirm it. But that *indifference* which I experiment, since no reason impells me to one part more than another, is the Lowest degree of *Liberty*, and witnesses no *perfection* therein, but only a defect, or a certain negation in *Cognition*. For if I could always see what is *True* and *Good*, I should never make any doubt, what is to be judged of it, or chosen out of it; so though I might be absolutely free, yet never indifferent.

IX.
Memory,
and in
what it
consists.

By the name of *Memory*, so far as can be collected from the descriptions of other *faculties*, is understood the *Power* which the *Soul* hath to conceive, feel or imagin, that which it hath already conceived, felt or imagin'd: And on the part of the *Body*, a certain facility which the *Pores* of the *Ventricles* of the *Brain*, which had before been relax'd by the *Animal Spirits*, have to open themselves again. For if we consider the Nature of those *Species* which are preserv'd in the *Memory*, we shall find that they are nothing but certain *Vestigia* or *Footsteps* which the *Agitation* and *Course* of the *Spirits* leave among the *Fibres* of the *Brain*, almost in the same manner, as *folde* in a complicated *leaf* of *Paper* retain a faculty of entertaining again those *forms* which had been before impress'd upon them; in regard that when the *Spirits* have a power of dilating the *Pores* of the *Brain*, of pleating, and variously disposing of the *Filaments*, through which they pass, according to the various *motions* in which they are carried, it comes to pass that the *Pores* have a certain power of drawing and directing the *Spirits*, so that at length they pass out through the same *intervals*, and in the same manner as formerly they went out; and so the said *Spirits* finding out those *Pores*, enter more easily into them than others; whence it happens that a *man* remembers any thing, when the said thing, having been formerly observ'd by him, hath left certain *Vestigia* in the *Brain*, by occasion whereof the said thing comes in mind.

X.
How we
come to be
able some-
times to re-
peat a
whole Ora-
tion.

Whence no wonder, if, upon hearing a *Narration*, or reading an *Oration*, which we have committed to *memory*, we are able afterwards to repeat the same, and that in the same manner as we heard or read it; because, as upon making of *folde* in *Paper*, the first *fold* being made, the rest constituted in the same *series* easily follow, as having regard to the said *series*. So that whatever *Vestigium* is first made in the *Brain*, the rest which have respect to that *series*, easily follow.

XI.
How we
come to re-
member
those things
which we
had forgot.

In like manner we remember things which we have forgotten, when we recollect a certain distinct *Vestigium* in the *Brain*, according as it occurs in the same *series*; from whence beginning to deduce and unwind the *series*, we proceed so far, till at length we discover that which, while hid, we enquir'd into. As in *Paper*, not meeting easily with some certain *fold*, we choose out some other distinct *fold*, occurring in the same *series*, from whence a deduction being begun, the *fold* which they hid is at length discovered.

XII.
What
things help
Memory in
the Brain.

All *Species* which help the *Memory*, are especially in the *Glandule* (which we have formerly declar'd to reside in the midst of the *Brain*) in regard that it is the principal *Seat* of the *Soul*; though other parts of the *Brain* are also sometimes

inseverant to *Memory*; nay, even the *Nerves* like-
wise and *Muscles*, as is observable in a *Minstrel* or *Musitian*, who hath something of *Memory* at his *Fingers* ends, since his dexterity in the moving of them, and shifting them up and down, which he hath acquir'd by long use, helps his *Memory* to the finding out of those places, to the *smiting* whereof he is disposed; and for the same reason the *Idea's* of two things occur in the *Mind*, if they were both impress'd together: For upon the beholding of any ones *Countenance*, immediately there occur, at one and the same time, *Eyes*, *Nose*, *Forehead*, *Lips*, &c. in regard when we beheld his *Face*, all those things appeared. Hence they who have once tasted of any *Meat*, wherein they have observed any thing that might hurt the *Eyes*, can never remember the said *Meat*, but that also will occur, that it offended the *Sight*. Neither can they endure to bear any other person *speaking* of such sort of *Meat*, but they will be affected with the same aversion; the cause whereof is, that the *Animal Spirits* excite the same *motion* in the *Glandule*, which they excited, when they first beheld the *Meat*.

Reminiscence is an addition of something above *Memory*; for it is not enough to remember that the *species* of a thing is simply objected, but it is also necessary, that when it occurs to us the second time, we take notice, that it therefore so happens, because it had been presented to our view before; for indeed *Reminiscence* is nothing but the *Resumption*, by present *Memory*, of *Cognition* first had, and then afterwards *Obliterated*; and much of the like Nature is the inquiry and recovery of the *Knowledge* of a *Man* whom we had forgot by reason of the present *memory* of *Places*, *Places*, and the like; and consequently there is required to *reminiscence*, that the *Images* of things be partly obliterated, partly not: For we are then said to *reminisce*, when, from the *Footsteps* of the *Images* which remain, we recollect something of those which were slipt from our *Mind*. Wherefore the whole difference which is between *Memory* and *Reminiscence*, consists only in this, that to *Memory* it suffices, if any *species* return upon the *Glandule*, and that *species* be received without any reflection: But to *Reminiscence*, besides that reception of the thing, it is required, that the return thereof be known to us, and that we may have *knowledge*, that we had it, or perceived it before.

From what hath been said, may be easily collected, that *Conscience*, or *Self-knowledge* is involved in all *Human Knowledge*, and is inseparable from it; for *Conscience* is so manifest and intrinsic to the *Mind*, that it cannot be abstracted from it; but upon that very account, it may be affirmed to be destitute of *Sense* and *Knowledge*, properly so called; for that which acts and suffers, and yet knows not that it acts or suffers, may be justly said to want *sense* in the said action or passion; as is clearly demonstrated in those who being wholly intent upon any thing, or being moved with *anger*, perceive not; for examples sake, the sound of a *Bell*, or any thing presented to the sight, and consequently neither are sensible of, nor acknowledge any of those things. From whence it appears, that *Conscience* is a certain *Species* of *Cogitation*, namely that immanent or inhering action of a thinking substance, by which it knows that

XIII.
What Re-
miniscence
is, and
what it
adds above
the Memo-
ry.

XIV.
Conscience
is included
in all
Knowledge.

that it hath a real *Cognition* or perception of any thing. Forasmuch as *Conscience* seems to be no other thing but the mind indued with knowledge, as well of it self, as of its own *Cogitation*: whence *CICERO* in the 3d. Book of his *Offices*; When, saith he, a *Matter* is to be propos'd to a person sworn, he is to remember that he hath *GOD* for a witness of what is said to him; that is to say, according to my Judgment, his own Mind. Whence it follows that we are convinced by *Conscience*, as by a clear and distinct Knowledge.

XV.
Even in
false Judgments.

Nor is it against our assertion, to say that the Mind is able to form various judgments, even tho' false, concerning its own perception, and intelligence; because the Mind is never deceived in this, namely, that it should know or understand, at that time when it thinks that it knows and comprehends. In regard this Perception or Cogitation is always perfected by the Mind in the Mind, and therefore it cannot be, that when I think that I receive any thing with my Ears, I should not have such a perception; nay though it were possible, and should often happen that I should not hear at all, and the Organ of hearing should not be affected with any thing, so long that I think that it is affected; as we find it falls out in our Dreams: So that in all Cognition, two things chiefly are to be observed; the first is *Conscience*, which is that *Animadversion* whereby we mark, or take notice of any thing; the other is that which is said to be *Animadverted* or observed, and is all that which is immediately apprehended by the Mind, and which in the first and second part of this Institution we have often call'd *Idea*.

XVI.
What Wit
is.

Now since the *Indowments* of Wit have also regard to the Soul, it may be here inquired, what Wit is, and whence so great a diversity of Wits arises, and why some men are more propense to certain Studies, and certain peculiar managements of Life than others. As to the first, some so describe Wit, as to call it a power implanted in man to understand, act and govern himself and others, to be approved in *Vertues*, or commit *Vices*; in all which generally one man very much excels another. In fine, Wit seems scarce to differ from *Ingenuity* or *Apineß*, and thereupon it may probably be said that it chiefly depends upon the Organs of the Body, and the disposition and contexture of the *Fibres*.

XVII.
Whence arises the
Diversity
of Wits.

As to the second, concerning the Variety of Wits, It can by no means or possibility be imputed to the diversity of Souls; for in regard all Souls are *Intellectual* and *Incorporeal*, and own no Author but *GOD* alone, they seem, according to Nature, to be altogether equal, (unless *GOD* for some certain ends should design to produce some more perfect than others) and then all the inequality which is deprehended in them, must proceed from the variety of the Organs, and especially of the Brain: We understand not human reason pure and abstracted from the Body, but the same so far as it is perfected or hindered, in any manner, by the disposition of the Body.

XVIII.
What are
the Indowments
of
Wit.

So *DES CARTES* in the begining of his *Dissertation*, concerning the method of rightly using Reason, reckons up three qualities of Wit; *Celerity* of Thinking, *Facility* of distinctly Imagining, and *Capacity* and use of Memory: Nor does

he acknowledge, that he knows any other qualities different from these, by which Wit can be rendred more excellent. But right Reason or a good Mind, that is, a Power of judging incorruptly and discerning true from false, he concludes to be equal in all, and distinguishes it from Wit.

Now whence should the *Celerity* of Thinking proceed, but from the agility and promptitude of the Spirits? for we see Men frequently after a chirping cup of Wine, to become more chearful; and indued as it were, with a new faculty of Thinking; whence that trite Adage, with little variation from *Horace*, Rich Wines make even Fools Philosophers. On the contrary, we see others of an acute Understanding and Sagacity of Wit, upon taking a Cup too much, or upon the Brain being ill affected, by never so small an indisposition, to become Heavy, Dull and Stupid, and very much unlike themselves, as to what they appear at other times, which certainly argues that the *Celerity* of Thinking, depends much upon the disposition of the Body, and that the inequality of the Operations proceeds from the inequality of the Organs.

XIX.
Celerity of
Thinking
depends
upon the
Spirits.

In like manner the *Facility* of distinctly Imagining, and the capacity of Memory having regard to the internal Sense, are acquired chiefly by use, and rendred familiar by long habit and custom; whence we find by experience, that not all Men are carried with the like proclivity to certain kinds of Studies, but that as in some Men there is one sort of ingenuity, in others another: So there is a various promptitude to attain to Sciences; for they that are prevalent in Imagination, are very comprehensive of Mathematical Demonstrations, but have not happy success in Metaphysical Speculations; which happens not for want of Ratiocination; but because in Mathematicks Imagination only, not Ratiocination is made use of. So *DES CARTES* Part 2. Epist. 33. That part of Wit, namely Imagination, which is chiefly conducive in Mathematicks, hurts more than profits in Metaphysical Speculations. The diversity therefore of Wits ariseth from the constitution of the Organs, and from the temperament of the Brain and Spirits; which disposition, nevertheless, in regard it varies infinite ways; no wonder some Genous are most inclined to Philosophy, others follow Mathematicks, others Musick. &c.

XX.
The facility
of distinctly
Imagining,
and capacity
of Memory
ariseth
from the
disposition
of the Body.

CHAP. VI.

Of the Affections or Passions of the Mind.

HAVING treated apart of the Nature of the Body and Soul, and distinguished the Functions of both, it remains that we say something of the Passions which are peculiar to Man, to whom nevertheless they are no otherwise Attributed, but as he consists of Body and Soul; for those Affections and Operations being neither belonging to the Mind alone, nor to the Body alone, proceed meerly from the Union and confederacy of Mind and Body; such as are the Passions, which are called Affections and Commotions of the Mind; because it is the Mind, which they principally shake and divers ways impel and disturb: For tho' the Senses depend also upon the said Union of Body and Soul, yet they gently insinuate themselves

I.
That the
Passions of
the Soul
are distinguished
from the Senses.

selves

selves into the *Mind*, and relate not so much to the *Soul* as to *External Objects*, by which also they may be deceived and drawn into an *Error*; but the *Affections* of the *Soul* are inward, and so adhere to it, that it cannot have experience of them any other way but as they are; whence it comes that they who are in a deep *Sleep*, seem to behold certain *things* with open *Eyes*, and to suffer those things in the *Body* which no way touch us: Yet nevertheless, it can be no way brought to pass, that we should feel our selves *sad* or *deeply in Love*, but that there must be really such a commotion in us, and that we are affected not with a *Feigned*, but *Genuine Love* or *Sadness*.

II.
The definition of Passion.

Wherefore the *Passions* of the *Soul* are thus best defined: The *Perceptions*, or *Senses*, or *commotions* of the *Soul*, which are *referr'd* especially to it, and which are *produc'd*, *conserv'd* and *corroborated* by a certain *motion* of the *Spirits*. They are first called *Perceptions*, because that name is common to all *Cogitations*; and we use it to signify all *Cogitations*, which are *produc'd* without the Concourse of the *Will*, and which are excited by impressions left in the *Brain*; for whatsoever is not *Action*, ought to be called *Passion*.

III.
Each part of the definition explained.

Next, they are called *Senses*, because they come to the *Soul* after the manner of *Senses*, and are of the number of those *Cognitions*, which by that freight bond that is between *Soul* and *Body* are rendred confused: But by a special term they are called *Commutations* of the *Soul*, in regard we are taught by our own experience; that no *Cogitations* enter into our *Soul*, which so much disturb, and move it as those do. It is moreover added, that they are especially *referr'd* to the *Soul*, to distinguish them which come from exterior *Objects*, or arise from interior dispositions of the *Body*, as the preceptions of *Colours*, *Odours*, *Sounds*, &c. which are referred to *External Objects*; *Hunger*, *Thirst*, *Pain* which are referred to our *Body*.

IV.
Passions depend upon the concurrence of the Spirits.

Lastly, it is concluded that those *Passions* are *produc'd*, *Nurish'd* and *Corroborated*, by a certain *peculiar motion* of the *Spirits*; to distinguish them from the proper *Acts* of our *Will*, which indeed may be called the *commotions* of the *Soul*, and also such as may be *referr'd* to the *Soul*, but which are not *produc'd* from the *Spirits*, but from the *Soul* it self. Whereas, in the *Passions* the *Animal Spirits* proceeding from the *Heart*, are carried into the *Brain*; and from their *commotions* ariseth the perturbation of the *Soul*, and being risen is *conserv'd*, so long as the *Animal Spirits* passing the same way, agitate the *Mind* by the same reason; and upon their increase, the commotion of the *Mind* may so increase as to be excited by them, not only to *judge*, but vehemently to *desire*, and sometime to grow *Mad*.

V.
How Human Passions are distinguished from the Affections of a separate Soul or Angel.

Whence the *Passions* which are incident to *Man*, as he is compos'd of *Soul* and *Body*, are distinguished from those which are belonging to a *Separate Soul*, or *Angel*; for there is no doubt, but that a *Soul* dislodg'd from the *Body* is toucht with various *Affections*, and is lyable to divers kinds of *Motions*: For seeing it hath a clear and distinct *knowledge* of *things*, it may also have *motions* attending the said *Cognition*; and so long as in those things it deprehends good or evil, it may refer them to it self, and consequently prosecute them with *Love*

or *Hatred*: For if it obtain that good which it hath judg'd convenient for it self, there cannot but arise much *Joy* thereupon; but if it find it self deprived thereof, *Sadness* will follow: Yet those *Passions* differ from ours, because they are not joint with the *motions* of the *Animal Spirits*, which excite and conserve them in us. Nay, they arise in them by a clear and distinct *Cognition* which they have, of the thing which they look upon and behold as their good.

But lest for the future any difficulty should arise about the word *Passions*, we assert that *Actions* and *Passions* in *Intellectual* and *Cognitive things*, are no other than what they are in *Corporeal things*; for as in a *Material thing*, *Action* and *Passion* consist in *Local motion*, being called *Action* when the *motion* is conceived to be in the *Mover*, and *Passion*, when it is considered to be in the thing *moved*; so in *Incorporeals*, *Action* is said to be, that which holds on the *Movers* side, as *Volition* in the *Soul*: *Passion* is that which keeps on the part of the thing *moved*, as *Intellection* and *Vision* in the same *Soul*. So the *Affections* which we take upon us here to describe, are called *Passions* in respect of the *Soul* to which they belong; but *Actions* in respect of the *Body*, which *Acts* immediately upon the *Soul*, and in its *Actings* effects mutation and variety.

But because in *Man* there are found various *Passions*, and those *Passions* obtain several *Names*, according to the diversity of *Agents*: We say, those *Passions* are only considered by us, which proceed from some particular *Agitation* of the *Spirits*, and whose effects are as it were felt in the *Soul*; for tho' other *impressions*, which are formed in the *Brain* by *External Objects*; or which depend upon the Footsteps of former *impressions* left in the *Brain*; or which by the ordinary course of the *Animal Spirits*, are presented to us *Sleeping* or *Waking*, may be called *Passions*; that is, so far as they are excited in the *Soul* without the concurrence of the *Will*: Yet to speak properly, they are not so much to be called *Passions*, as *Habits*, or *Propensions* which dispose to some *Passion*, since they move not the *Soul*, nor depend, or are cherish'd by any special course of the *Animal Spirits*.

Although the *Agitation* of the *Spirits*, may be called the proximate cause of our *Affections*, yet there are other remoter causes, which may be assigned, as the *Temperament* of our *Body*, which conduces not a little to the exciting of *Passions* in the *Brain*; since it is in the stead of *Disposition*, and after a sort impells the *Soul* to follow its propensions: Hence, those who have their *Body* any way disposed to *Love*, easily suffer their *Minds* to be drawn away to those *Cogitations*, by which they are excited to the said effect.

The second *Principle* is those *Objects*, which incur into our *Senses*; as any terrible *Figure* excites the *Passion* of *terror* in the *Soul*; whereas a grateful *Figure* which courteth the *Eyes*, causeth *Joy* and *Benevolence*, in regard the *motions* convey'd from *External things* to the *Brain*, variously dispose the *Spirits* thereof, and thereupon there arise different *Affections* in us: So that who ever desires any thing of us with a smooth *Tongue*, down-cast *Eyes*, and a *Body* disposed to *Humility*, will more easily obtain his desire of us, than another

VI.
Affections are call'd Passions in respect of the Soul, Actions in respect of the Body.

VII.
Passions ought to move the Soul.

VIII.
The various causes of Affections. First Temperament.

IX.
The second cause of Passions is the Object.

ther, who on the contrary, with a severe Countenance, an imperious Tone of Voice, and more like a Commander than a Suppliant demands the same.

The third Cause, is the Action of the Soul it self, as often as according to its innate Liberty, it proposes such or such Objects to be considered, in the long meditation where the Passions arise.

The fourth Cause is, the first Disposition of the Body in regard not only Affections; may be excited in us by Rational motions of the Mind, whilest it knows what to prosecute with Love or Hatred; but also by those first Dispositions of the Body, that procreate those obscure Sensations of Good and Evil, which happens to the Body, as DESCARTES intimates in his Epistles. Behold, saith he, four Passions, Joy, Love, Sadness and Hatred, which I suppose being first in us, we had before our Birth, and judge them to be no other than very confused Sensations or Cogitations; in regard the Soul was so tied to Matter, that it could not yet attend but to those divers impressions, that were to be received from it: And tho' after some years, it began to be affected with other Joys, and other Loves than those which depend only upon a right Disposition, and convenient Aliment of the Body; nevertheless that which was Intellectual in its Joys and Loves, had always concomitant those Senses which the said Passions first excited in it; yea, and those Natural motions and functions which were then in the Body.

So by reason, that before the Nativity Love did not arise but from a convenient Aliment, which flowing in great plenty into the common Ocean, the Heart and Lungs, excited in them a greater heat than usual; hence it is, that the said heat always accompanies Love, tho' proceeding from far different Causes.

Now we may observe, that there is a threefold degree in the Affections of the Mind, answerable to a threefold degree of the Senses. The first is the commotion or alteration of the Heart, the Blood and the Animal Spirits: The second being a consequent from the first, is the perception of the Mind. And lastly, an access of perturbation of Mind, so far as it precipitates inclination or aversion of Judgment or Will, is the third degree in the Affections.

CHAP. VII.

In what part of the Body the Soul receives its Passions.

From what hath been said, is sufficiently manifested, that Human Soul is joind to the whole Body, and that the motions thereof so depend upon its Cogitations, that they may be said to make one compound. Hence that common saying among Philosophers, That the Soul is whole in the whole Body, and whole in each part thereof: Not that the Soul can positively, and by true extension be found in each part of the Body, for that is repugnant to immaterial Substance, such as we have already demonstrated Human Mind to be; but because the Body is one certain thing, and in a certain peculiar Sense Individual, namely in respect of the disposition of the Organs; all which

are so mutually related one to another, that any one being taken away, the Body is thereby rendered maimed and imperfect; and since such is the Nature of the Soul, that it is void of all Extension and Dimensions, it can be referr'd to no Member of the Body so as to equal its quantity, but only to the whole Compages of the Organs which is considered as one; whence it comes to pass, that any part of the Body being cut off, the Soul could not be conceived a jot less, nor if any could be added, a jot greater.

But tho' the Soul were joind to the whole Body, yet it could be said more intimately and immediately to be united to one part than another. Thus GOD, tho' he be diffused through the whole World, and by his Power in a manner fills all places, yet in a peculiar way he may be said to be in Heaven, where he Governs and Rules all things as he pleaseth. So we say, that Human Mind resides in the Brain, as in the upper part or Cittadel of the Body; and that not promiscuously neither in all its Parts, but more especially it hath its Seat in the Conarion, whose office it is to receive the Animal Spirits, and to unite in it self the Images proceeding from Corporeal Organs: For this is that part, wherein the Soul most proximately and especially exerciseth its Functions, by perceiving and willing all things which proceed from the Body, or have their tendency into it.

The reason why such a Glandule is asserted to be in the Brain, and to be the Seat of the Common Sense, I have already declared, to which others may be added, whereof this is not the most inconsiderable, that our Soul is one and undivided, and consequently it seems most consentaneous to reason, that that part of the Body to which it is immediately joind be also one; and since there is no part in the Brain besides this Glandule which is not double, it seems most probable to be the Seat of the Soul; and that which conduces not a little to the confirming of this Opinion is, that this pineal Glandule is as it were seated in its Throne, from whence it may, as I may so say, have a fair prospect into all the 4 Ventricles of the Brain, and so may easily receive impressions from the Nerves that come from all parts: Moreover this Glandule is sufficiently agile and moveable, as being hung upon two Nervous strings, so that it may be moved this way or that way, according to the arbitrement of the Mind; which is the thing chiefly required in the common Sensorium, for otherwise the Spirits could not tend one way more than another.

These things thus briefly stated, it must be concluded, that the Passions have their chief residence in the Brain, not in the Heart, as some would have it; since when ever there are Cogitations or Senses, as above noted, they are produc'd by the Mind in the Brain; nor is what we affirm rendered invalid by saying, that the Passions, which are always accompanied by some commotion of the Blood and Spirits, may be as it were felt in the Heart, for that so happens because all the Nerves of our Body, are extended as certain Filaments into all parts of the Body: So that when it suffers Pain in any of the Members, for Examples sake, in the Foot or Leg, it is not to be imagined that the Soul makes use of its faculties in those parts; but rather that it feels Pain, by

II.
Human Mind is in a peculiar manner in the brain.

III.
Of what use the Glandule in the Brain is.

IV.
That the Passions chiefly reside in the Brain.

X.
The third is the Action of the Soul.

XI.
The fourth cause is the first disposition of the Body.

XII.
Which appears in Love.

XIII.
Three degrees to be observed in the Passions

I.
The Soul is joind to the whole Body.

the ministry of those *Nerves* which are extended from the said *Members* to the *Brain*. No otherwise than when one end of an extended *Rope* is drawn, the other is immediately moved, as hath been above declar'd.

V.
In what
Order the
Passions are
form'd.

So the *Blood* being well tempered, and expanding it self more than usually in the *Heart*, the little *Nerves* being diffused about its *Orifices* are so loosened and agitated, that there follows thence another *motion*, which affects the *Mind* with a certain Natural *Sense* of *hilarity* or *cheerfulness*. So upon the imagination of the *fruition* of any good, the *Spirits* are sent from the *Brain* to the *Muscles*, and by their help the *Orifices* of the *Heart* are dilated, and its *Nervules* mov'd in that motion, from whence the *sense* of *Joy* cannot but follow. In like manner, upon the receipt of a grateful *message*, as soon as the *Mind* perceives it, the *Spirits*, from the *Brain*, flow to the *Muscles* of the *Bowels*, and there moving the *Nervules*, by their means excite another motion in the *Brain*, which affects the *Mind* with a *lively sense* of *Joy*. And by the same reason, the *senses* of *Sadness*, *Love*, *Hatred*, *Anger*, *Fear*, &c. are communicated to the *Brain* through the *Nervules* of the *Bowels*, and there immediately, and most especially affect the *Mind*, and consequently reside therein, as in their primary *Seat*; but in the *Heart* and other parts affected by them, as in their secondary *Seat*.

VI.
It is not necessary that the Soul be in the Heart, thereby to perceive Passions.

Therefore whilst in the *perturbations* of the *Mind*, we observe a certain alteration, as it were, inhering in the *heart*; we must certainly conclude, that our *Mind* perceives not but by the help of some *Nervule* which reaches from the *Brain* to the *Heart*; and there is no more necessity that the *Soul* should immediately exercise its *functions* in the *Heart*, because it feels its *Passions* therein, than that it should be in *Heaven* as often as it perceives the *Rays*, and the *Globular Pression* made by the *Sun*.

VII.
The more vehement Motions of the Spirit may disturb the Soul.

Hence it often happens, that divers *affections* arise in the *Soul*, namely, when the *Spirits* are otherwise disposed by the *Mind*, than by the *Objects*, or their own temperament. In regard that *Human Mind*, tho' it be wholly rational, yet does it not always make good use of its own *reason*, but is greatly disturbed by *external things*; so that the *Body* by its *Spirits*, and the *Soul* it self by its *Will* may excite different *Motions*; and herein consists those conflicts which are vulgarly said to interceed between the lower and upper part of the *Soul*. For since all our *perceptions*, as well those which proceed from the *Will*, as those which depend upon the *Impulses* of the *Spirits*, contain something evident in them, that may invite to prosecute this or that *Object*; this by *Love*, that by *Hatred*: the *Glandule* may be drawn one way by the *Soul*, another way by the *Animal Spirits*; from which different *motions*, the *Soul* feels it self alternately inclin'd, one while to take one part, another while the other; and in this one thing consists their repugnance: yet not so, as that the *Soul* can at one and the same time be carried two contrary ways, or the *Glandule* be at the same moment inclin'd to opposite parts, but only upon this account, that the *force* wherewith the *Spirits* incline the *Glandule* on one side, and wherewith the *Mind* struggles with its *Will* on the other

side, hath this effect, that the *Soul*, almost at one moment, feels it self stirr'd up to have an *affection*, and *aversion* for one and the same *Object*.

CHAP. VIII.

Of the Order and Number of the Passions.

ALTHOUGH the *Soul* depends not upon *Corporal Objects*, so as to *think*, and without any *material Species*, to be able to comprehend all sorts of *things*: And tho' in the forming of the *Passions*, it sometimes makes use of its own *intelligent faculty* alone, and can at pleasure apply it self to conceive sometimes one *Object*, sometimes another; yet it is manifest from what hath been said before, that the *passions* may also be excited by *Objects* which move the *Sense*: Nay, and that these *Objects* are the most especial and common *principles*: so that to find *passions*, there needs nothing but to weigh the nature of the *Objects*, and to take notice of the *Effects* which proceed from them. But because in *man* they are many and various, and many times so confus'd among themselves, that they can scarce be distinguish'd from each other; we must mind the diversities of *Objects* which present themselves to our *Senses*, that by the perception of them, we may the more easily arrive at the knowledge of those *affections* which are begotten in us. Yet there is no necessity that all the diversities of *Objects* should be examined; but those alone which can either profit or hurt us, or any other way be relating to us.

Wherefore the better to enumerate the *Passions*, we are only to take notice how many several ways *Objects* may concern us, or may act upon our *Senses*, so as to profit or hurt us. Nothing is more frequent in *Schools*, than to take the *Soul* in pieces and to divide it, I know not by what *Art*, into *Sensitive* and *Rational*, by which they constitute two *Appetites* in the *sensitive part* of the *Soul*; whereof one they call *concupiscible*, which resides in the *Body*, and tends wholly to its *Conservation*; the other *Irascible*, which comes nearer to *Reason*, and supplies it with *strength* and *vigor*. But hence arose this Error of assigning 2 *persons* as it were in a *Scene*, that they did not carefully distinguish the *Functions* of the *Soul* and *Body*, but attributed to the *Soul* those *Offices* which belong to the *Body* only. For whatsoever opposes *Reason*, cannot proceed but meerly from the *Body*, which comes to pass when the *Animal Spirits*, which are also *Bodies*, hit by an opposite way upon the *Glandule*, and by their *power* endeavour to hinder the effect of the *Soul*. For in one *Body* there is to be considered but one *Soul*, void of all *parts*, and being but one and the same, called both *Sensitive* and *Rational*.

But if those *Authors*, who admit 2 *Appetites* in the *Soul*, only mean this, that the *Soul* is indued with 2 *Functions*, the one of *Lusting*, the other of being *Angry*, we shall not gainsay them; but whereas it hath the *faculties* not only of being *Angry*, and being *Concupiscible*, but also the faculty of *Admiring*, *Hoping*, *Fearing*, there seems to be no reason that all *affections* should be referred to *Concupiscence* or *Anger*; when as *Admiration*,

I.
Passions are made different from their Objects.

II.
The Soul is void of partition, and consequently is indivisible as Irascible and Concupiscible.

III.
There are divers faculties in the Soul.



IV.
Admirati-
on the first
Passion that
occurs to us.

miration, which is the primary Affection, hath no relation either to *Concupiscence* or *Anger*.

Therefore another way must be found out to enumerate the *Passions*; and in my mind there can be none more convenient, and more certain, than for all the *motions* of the *Mind*, which occur to us, to be considered in their *Order*. For as soon as any thing presents it self to us, or appears under any *species* which hath no similitude with any thing we knew before, it causes the *Soul* to be surpris'd at the sight thereof, and to remain some time in *contemplation* upon it; and in regard this may possibly happen before we have well considered whether the said thing represented to us be good or bad for us, it hence follows that *Admiration* is to be accounted the first of all those *Affections* which are inbred in us; but since it happens that we either *admire* the excellency of any admirable *Object*, or condemn the despicableness of any other, either *Esteem* or *Contempt* must needs accompany this *Admiration*, and by this means *Magnanimity* or *Abjection of Spirit* are created in us; namely, while we either extol our selves for some just cause, or condemn our selves for that pusillanimity which we find to be in us: But when we esteem greatness of *Action* in other persons, whom we esteem capable of doing *Good* or *Ill* to *Mankind*; from such an esteem as this proceeds *Veneration*.

V.
The next
are Love,
Hatred, Cu-
pidity,
Hope, and
the like.

In the next place, when the *Soul* considers under some qualification an *Object* of *Good* or *Evil*, that is, of what is either agreeable or ungrateful to us, having no regard to difference of time therein, it excites either to *Love* or *Hatred*; forasmuch as *Love* is an *Affection of Union*, as *Hatred* is of *Separation*. But when respect is had to time, that is, when a man is more carried on to the *Contemplation* of the future, than of the present or past time; a future *Object* is expected, either as only possible, or moreover as *easy* or *hard* to be obtained. From the former consideration is kindled *Cupidity*, by which not only the presence of an *absent Good*, and the conservation of what is posselt is desired, but also the *Absence* of an *Evil*, as well present as in *apprehension*. But if a thing be represented, not only upon the account of possibility, but also as *easy* of acquisition, it begets *Hope*, the utmost degree whereof is *Trust* or *Security*. But if it be lookt upon as difficult to be obtain'd, it creates *Timidity* or *Fear*, the utmost degree whereof is *Despair*: Hitherto may be referred *Doubtfulness* or *Fluctuation* of *Mind*, when we dispose our selves to deliberate or enter upon *Counsel*.

VI.
Here fol-
low those
Passions
which con-
sider Good
and Evil
as present.

Lastly, when *Good* and *Evil*, as being considered to have relation to us, are present, they produce 2 other *Effects*; the first *Joy*, the other *Sorrow* or *Sadness*. But when we look upon them as relating to others, we judge those persons either worthy or unworthy of so great a *Good*. If worthy, it produces gladness in the *Soul*, either *Serious* or mixt with *Derision*: If unworthy, the good which attends upon them stirs up *Envy* or *Heart-burning* in us; and if bad attend them, it stirs up *Commiseration*, which is a kind of *sadness*.

VII.
Acquies-
cence, Peni-
tence, Glory,
&c.

In an *Object* past, or even also present, attention may be had to the Cause of *Good* or *Evil*. A *Good* which has been done by us, if it relate to opinion we have of it as *Good*, it begets an inward acquiescence or contentment, which is the

sweetest of all *passions*, and wonderfully delights the *Soul*; whereas an *Evil* done, if it relate to the *Opinion* we have of it as *Evil*; brings forth *repentance*, which is the most troublesome of all the *passions*, and incessantly disturbs and afflicts the *Soul*. A *Good* done by us, as it relates to the *Opinion* which others conceive of it, produces *Glory*; on the contrary, *Evil* so relating, *Shame* and sense of *Disgrace*. If a *Good* be conferred upon us by another, we testify our *Gratitude* towards him: If the same *Good* be bestowed upon another, he is the *Object* of our *Favour*: On the other side, if an *Evil* be inflicted on others, it causes our *Indignation*; if on our selves, our *Anger*; which two last *Affections* may be said to be *species* of *Hatred* or *Aversion*. A long *Duration* or *Continuance* of *Good* induces *Satiety* or *Loathing*; as on the contrary, *Duration* of *Evil* diminisheth *Pain* or *Misery*, and renders it more light and tolerable.

Lastly, from a past *Good*, upon remembrance of the *Joy* thence received, there springs up *Desire*, as from an *Evil* happily surmounted, *Hilarity* arises, which may be referred to *Joyfulness*. Now altho' we have here enumerated several sorts of *Passions*, yet if they be each of them well considered and examined, it will soon appear, that many of them are referrible to others as *primitive* ones, which are reckoned only 6 in number, namely *Admiration*, *Love*, *Hatred*, *Cupidity* or sensual desire, *Joy* and *Sadness*: The rest are *secondary*, being either compounded of many of them, or referrible to them as to their *Genus*'s.

VIII.
Desire, Hi-
larity, &c.

CHAP. IX.

Of Admiration.

Admiration leads up a Troop of *Passions*, being the first and chief of all that affect *Human Mind*, and upon which all the rest, in some sort or other, depend. For as in other *Functions* of the *Soul*, *Apprehension* precedes *Judgment* and *Discourse*, and it is necessary that some *Object* be represented before such time as the *Soul* gives or denies assent thereunto: So any thing whatsoever is perceived by *Admiration*, before any one can prosecute it with *Love* or *Hatred*, or can *Covet* it, or conceive *Joy* by the obtaining of it, or *Sorrow* by the want of it.

I.
Admirati-
on precedes
all other
Passions.

Now *Admiration* is a sudden impulse of the *Mind*, by which it is led to an attentive consideration of those *Objects* which seem unwonted to it, and with the novelty whereof it is surpris'd. This *Passion* belongs to the *Brain* alone, and hath no commerce with any other parts of the *Body*, as other *Passions* have, which are referred to the *heart*, and which the *motions* of the *Blood* and *Spirits* ever accompany. That this is peculiar to *Admiration*, may be collected from hence, namely, that when ever this *Passion* is imploy'd in the attention of the thing perceived, and only regards the novelty thereof, it hath no consideration therein either of *Good* or *Evil*, and consequently hath no correspondence with the *Heart* and *Blood*, upon which the whole concern of the *Body* depends, but only with the *Brain*, in which are laid up all those *Instruments* which conduce to the forming of this *Cognition*.

II.
The defini-
tion of Ad-
mirati-
on.

The

III.
What produces Ad-
miration.

The Cause of this *Affection* is the very Impression made in the *Brain*, according as it represents some Extraordinary Object, worthy the *Souls* Employment and Attention. For the Novelty of the thing hath somewhat of Gratefulness, which takes the *Beholders*, and draws their Contemplation to it. Hence it comes to pass, that we admire all things that are Novel, and those always please most that came latest into our *Sense*. To confirm what hath been said, the motions of the *Spirits* are not a little conducing, which are dispos'd by that Impression, and with great Violence direct their Course towards that part of the *Brain* in which it was form'd; and so far as they receive from it a disposition to pass into the *Muscles*, which serve to retain the *Organs* of the *Senses* in the same Position.

IV.
The force and efficacy of Admi-
ration.

Altho' *Admiration* takes beginning in the *Brain*, and is wholly employ'd in the Contemplation of a New and unwonted Object; yet nothing hinders, but that by the said Impression which it makes in the *Brain*, it may act upon our *Body*, and imitate the Efficacy of other *Passions*. Nay, sometimes it grows so prevalent, that it seizeth on our *Body* more strongly than they, and exercises its Power upon it much more forcibly; which chiefly proceeds from hence, namely that the Novelty from whence it springs, brings forth *Motions* the most prompt of all, and such as have their whole strength at the beginning. Nor can it be doubted, but that these sort of *Motions* are stronger, than those which are increas'd by degrees, and have no strength, but what they acquire by little and little. Since it is most certain, that such like *Motions* may either be averted, or stopt by little labour; whereas the sudden Surprizal of a New thing, admits of no such aversion, since it can scarce be discern'd, and insinuates it self in a moment. For as we can stir *Hand* or *Foot* almost in the same Moment in which we think of *Moving* them; in regard the *Idea* of this sort of *Motion*, which is form'd in our *Brain*, sends *Spirits* into the *Muscles*, fit to effect that said *Motion*: So the *Idea* of a grateful Object, which comes unawares into the *Mind*, immediately by the help of the *Nerves*, sends *Spirits*, which opens the *Orifices* of the *Heart*. Nor does *Admiration* any thing else in this business, but by its Novelty add Strength to the *Motion*, and causes the *Blood*, which upon the sudden dilating of the *Orifices* of the *Heart*, flows through the *Vena Cava* into it, and goes out through the *Vena Arteriosa*, suddenly to inflate and expand the *Lungs*.

V.
A Novelty affects the
Brain in
an un-
wonted
manner.

To which *Reasons* another also may be added, namely, That those Things which outwardly excite *Admiration*, when they are New, and have not yet arriv'd through our *Senses* to the *Brain*, strike it in some certain Parts, where it hath not been struck before; and since those Parts of the *Brain* are more soft and tender than the rest, it falls out that they receive the Stroke deeper, and the *Affections* of the *Motions* which are there begotten, are, by reason of their unwontedness, render'd more Vehement.

VI.
Esteem and
Contempt,
Species of
Admira-
tion.

There are 2 Species of *Admiration*, *Esteem* and *Contempt*, which are not to be taken for simple *Opinions*, that without *Passion* may be entertain'd concerning the Value of any thing whatsoever, but for the *Affections* which arise

from those *Opinions*: *Esteem* therefore is a propension of the *Soul*, produc'd by the Motion of the *Spirits*, to represent to its self the Value of any thing whatsoever. And *Contempt* is the opposite propension which the *Soul* hath to consider the Littleness or Vileness of the thing Contemn'd: which *Passions* may be referr'd not only to External Objects, but even to our selves; as namely, when we strictly enquiring into our selves, find Reason to suspect or despise our own Merit. But in regard we often flatter our selves, and judge that more laudable, which is done by our selves, than by others; it will be worth our while to understand what it is, for which we may entertain a Self-esteem. And truly, I can see nothing that I judge can be Entitled to this Merit, but the right use of our *Free will*, and that Greatness of *Soul* by which we govern our *Wills*, and subdue them to the Yoke of Reason. Forasmuch as other Goods, which are out of our power, can conduce nothing to our Good, and consequently deserve not our Esteem or Praise. Only those Actions, which depend upon our Will, can confer upon us the Merit either of Praise or Dispraise; since by the use thereof we are render'd in a sort like to GOD, and come so much the nearer to his Image. In this alone true Generosity consists, when a Man well knowing that nothing properly is his own, except the free disposition of his Will, duly Values himself as he sees Cause, upon the right use of his Reason, and retains a firm purpose always to act those things which he shall judge to be most Excellent.

Veneration, which considers Objects without us, is an Inclination of the *Soul*, by which it is carried, not only to Esteem the Person which it honours; but also to Subject it self to him with a certain Fear, for the sake of gaining his Favour. Whence it comes to pass, that Veneration proceeds only from the Consideration of Power, which we conceive to be in a Free Agent, wherewith he is able either to benefit or hurt us; although all this while we know nothing of his Will, that is, we are not certain which of the two will befall us, Good or Harm. So in Old times, some venerated Mountains, Temples and Groves, not that they believ'd, that these Works of Art and Nature were GODS; but because they imagin'd, that certain Divinities lay hid in them, which might at their pleasure either do them Good or Hurt.

To this Passion, *Dedignation* or *Disesteem* is oppos'd, by which we despise Free Causes, though at the same time we judge them to have power of doing Good or Harm; because we think them so much beneath us, as not to be capable of Executing their said Power upon us.

Stupour, or Amazement, is an Excess of *Admiration*, which happens to us when a sudden Surprizal causes the *Spirits*, which are included in the Cavities of the *Brain*, so to advance to that place in which the Image of the Object, which we admire, is form'd, as sometimes to carry all to the said place, and to make them so employ'd in Con-serving that Image, that from thence to the *Muscles*, from those *Vestigia* which they first follow'd in the *Brain*, no way lies open to any others. Whence it happens, that the *Body* remains wholly immoveable in that State wherein it first was; and

VII.
What is
Veneration

VIII.
Effects of
Dedignation.

IX.
An Excess
of Admi-
ration be-
gets Stu-
pour.



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G. Freeman Inv

J. Kip Scul

To the Right Noble
and Countess of
Viscountess Falmouth &



Catherine Dutches
Northumberland
Baroness of Pontefract &c.

This Plate is humbly

Dedicated by Richard Blome

and nothing but the first *Image*, which first occur'd to the *Mind*, can be deprehended, nor can a more exact Knowledge thereof be thereby gain'd.

CHAP. X.

Of Love and Hatred.

I.
Why Love
and Hatred
are to be treated
of together.

Altho' *Hatred* be oppos'd to *Love*, and they both of them never agree in the same *Person*, about the same *Object*, nevertheless it is Expedient to joyn both together in this one *Chapter*, that by comparing the Nature of them both, one with another, it may the more appear wherein they most chiefly differ.

II.
The Definition
of Love.

LOVE is defined, a *Perception or Commotion of the Soul*, generated by a *special Motion of the Spirits*, whereby it is excited to joyn it self by its *Will* to those things which seem grateful to it. On the contrary, **HATRED** is a *Commotion of the Soul*, produc'd by the *Spirits*, by which it is incited to separate it self, by its *Will*, from *Objects* which are represented as ungrateful and noxious to it. But in regard the *Soul* applies it self to those things which it judges *Good*, and is averted from the very same things, so far as they are represented to it under the Notion of *Evil*; not only by *Love* and *Hatred*, but also by *Judgment*; we add, that *Love* and *Hatred* are caus'd by the *Motion of the Spirits*, which is peculiar to all *Passions*, and which separates them from other *Perceptions of the Soul*. To joyn our selves by *Will* to any *Object*, is not to tend to that which is future, and to covet it as a thing *absent*; but to consent by *Affection*, which happens when we consider our selves, as it were already joyn'd to the thing *belov'd*, that is, when we conceive our selves to make up, as it were, one *Total* with it, and whereof we think our selves to be but one part, and the *Belov'd thing* another. But in *Hatred*, we consider our selves as a *Total*, wholly separated from the *Object*.

III.
What
things pro-
duce Love
or Hatred.

The *Causes of these Affections*, are *Objects* which may be represented to the *Soul* by the *Internal Senses*, to wit, its own proper *Reason*. For that is generally accounted *Good* or *Evil*, which is judg'd by our *Internal Senses*, either agreeable or contrary to our *Nature*. Or else by the *External Senses*, by which the *Beauty* or *Deformity* of things is apprehended. For we commonly judge those things *Beautiful* or *Deformed*, that court or offend our *Sight*; which, in that particular, excels all the rest of our *Senses*. Hence we are inclin'd to things *beautiful* and *fair* by that part of *Love*, which may rightly be call'd *Complacence*. *Evil* and *Deformed things*, we prosecute with *Hatred* and *Horreur*. The said *Love* may also be called *Benevolence*, in regard we affect not all things with the same *Affection*: For according to the *Esteem* we have of them, we love some things more, and some things less; whence *Philosophers* have been forc'd to invent several *Names*, for the making a distinction between some sorts of *Love* and others.

IV.
There are
three sorts
of Love.

For when we set a less *Value* on any *Object*, than upon our selves, and think it inferior to us, we may be said to have a *Propension*, or sort of *Benevolence* towards it. When we have the

same *Value* for it as for our selves, and *Opinion* of *Merit* makes no difference between us and that, we are tied to it by that which we call *Friendship*. But if we place more *Worth* and *Merit* upon the *Object*, and admire it above our selves, it becomes the *Object* of our *Devotion*, *Reverence*, or *Worship*. So that *Love* may be distinguish'd into *Benevolence*, *Friendship*, and *Devotion*, as into three *species* or diversities, wherein it wholly consists: For things *Inanimate*; or *Animals* void of *Reason*, may be *belov'd*; but no such thing as *Friendship* can be, but between *Man* and *Man*; that is, not as to the *Sex*, but as between one *Human Creature* and another; in whom it is so innate to be United each to other, that neither of them can be so vile or contemptible in the others *Eyes*, as not to be thought worthy to be joyn'd to the other by some *Tye* or *Relation*, provided he know that he is *belov'd* and be indued with a *generous Spirit*.

But by *Devotion* we are affected most chiefly to the *Supream Deity*, whom if we knew to that degree as were fit, we could not but love, tho' it may be said that *Subjects* to their *Prince*, *Natives* to their *Country*, *Citizens* or *Towns-men* to the *City* or *Town* where they were born or bred, are carried with a sort of *Devotion*, as Valuing the said *Objects* thereof above themselves, and thinking it their *Duty* to expose, if need be, their own *Lives* upon their account.

V.
Devotion
is chiefly
directed to
the Deity.

The *Cause of Love and Hatred*, as also of the three other *Passions*, is not, as that of *Admiration*, in the *Brain* alone; but also in the *Heart*, *Liver*, *Spleen*, and other *Parts of the Body*, which conduce to the generation of the *Blood*, and the conveyance of the *Spirits* thence. For altho' the *Blood* is carried to the *Heart* through the *Veins*, by a *Circular motion*; yet sometimes it happens to be impell'd into it with a more violent Force through some *Veins*, than through others. It happens also, that the *Passages* by which the *Blood* enters into the *Heart*, or by which it issues out of it, are by some Accident or other, made more wide or more narrow. Hence in *Love* there arises a *Notable agitation of the Blood and Spirits*, when the *Impression of the Lovely Object*, form'd in the *Brain*, conveys the *Animal Spirits* through the *Nerves* of the *gth Conjugation*, to the *Muscles* of the *Stomach* and *Intestines*, that so the *Chyle* or *Alimental Juice*, which by an iterated Circuit passing through the *Heart*, is turn'd into *Blood*; may pass on very swiftly to the *Heart*, and makes no stay either in the *Vicine parts*, or elsewhere; but with a rapid Course entering into it, stir up a more than ordinary fierce *beat* or *fire* therein: Because then the *Blood* becomes rarefied, and sends the more enlivened *Spirits* into the *Brain*; which *Spirits* corroborating the *Impression* which the first *Perception* of the amiable *Object* forms, Cause the *Soul* to rest in that *Perception*, and to take notice of the said *Object*, as acceptable and good.

VI.
The Causes
of Love
are in di-
vers Parts
of the Body.

On the contrary in *Hatred*, the first perception of the thing we have an aversion to, so draws down the *Spirits* which are about the *Intestines* and *Stomach*, that they hinder the *Chyle* from mixing with the *Blood*, that is, by Compressing all the *Orifices*, by which it uses to flow down thither, and at the same time transmits some of this *Chyle*

VII.
Hatred
proceeds
from differ-
ent Causes.

R r r r

through

through the *Nerves* of the *Milt*, and lower part of the *Liver*, which is the receptacle of *Choler*, with other *Blood* to the *Heart*, which causes no small inequality in its *Heat*, because the *Blood* that proceeds from the *Milt*, hardly suffers alteration, and can scarce be *Heated* or *Dilated*: Whereas the *Blood* that proceeds from the lower part of the *Liver*, which is the receptacle of the *Gall*, is rarefied and expanded in a Moment. Wherefore the *Spirits* transmitted from the *Heart* toward the *Brain*, consist of parts of different Vertue, and are agitated with unequal motions. Whence it comes to pass, that they there corroborate and fortify the *Thoughts* of *Hatred*, which they find newly formed, and weary the *Soul* with thoughts of *Melancholy* and *Sourness*.

VIII.
Various effects of Love.

There are reckoned up many effects of *Love*, as the *Pulse* of the *Arteries* being equal and more intent and vehement than usual; a calm *Heat* glowing in the *Heart*; a suddain Concoction of the *Meat* in the *Stomach*, and the like; but the most principal of all, and which most chiefly requires our consideration, is a kind of *Languishment*, which is no other than a certain proclivity to a cessation of motion, which proceeds from hence, namely, that the *Pineal Glandule* disposes not the *Spirits*, which are in the Cavities of the *Brain*, to flow into one *Muscle* rather than another. This *Languour* is produc'd by *Love*, when the thing desired cannot for the present be obtained, for then *Love* so detains the *Soul* in the Cogitation of the beloved *Object*, that it makes use of all the *Spirits* in the *Brain*, to represent to it the *Idea* thereof, and stops all other motions of the *Glandule* which conduce not to this effect.

CHAP. XI.

Of Affections.

I.
Cupidity no less disturbs us than those Passions that respect the future.

Since all the *Affections* of the *Soul*, except *Admiration*, tend towards *Good* and *Evil*, and are given us by nature, for the aiming at what is profitable, and rejecting of what is hurtful to us; it is to be considered how many ways it may be done: For since in *Love* and *Hatred*, there is no respect had of time, and only the convenience or inconvenience of the *Object* is lookt upon, these *Passions* seem to agitate, no less than those which tend towards the future, and seek after the *Object* with a kind of *Anxiety*: Hence the Cogitations of young Men which regard things to come, are more precipitous, and more sharply molest and disquiet their *Minds*, such as are *Hope*, *Fear*, *Jealousy*, &c. which are species of *Cupidity*.

II.
What Cupidity is, and how it comprehends as well an aversion of Evil as desire of Good.

Cupidity therefore or desire is a commotion of the *Soul* produc'd by the *Spirits*, whereby it is carried towards *Good* as a thing to come; by which *Passion* we not only wish for an absent thing, whose presence we judge convenient for us, but likewise the conservation of the thing possessed; nay, if we strictly inquire into the Nature of *Cupidity*, we by it no less desire the absence of an *Evil* not present, than the presence of that which is *Good*, and which we apprehend may possibly happen, so that *Cupidity* comprehends not only the desire of *Good*, but also the declining or aversion of *Evil*: For as much as to speak properly, there is one and the same agitation of *Mind*, by which

at the same time we are moved to aim at some *Good*, for Example sake, *Honours*, and to decline a contrary *Evil*, that is to say, *Ignominy* or *Disgrace*: For since there is no assignable *Good*, whose privation is not an *Evil*, nor any *Evil*, if it be considered under a positive respect, whose privation is not a real *Good*, there seems no reason to distinguish between that Appetite by which we affect the *Good*, and that by which we decline and reject its contrary.

All the difference that can be conceived in them, proceeds only from the *Passions* which accompany this various desire, namely, because to the *Cupidity* by which we tend to any *Good*, there are annexed *Love*, *Hope*, *Foy*, &c. and to the same *Cupidity*, by which we are carried to the *Aversion* of any *Evil*, there are joyn'd *Hatred*, *Fear* and *Sadness*; wherefore if *Cupidity* be considered according as it tends to the Prosecution of *Good*, or *Aversion* of its contrary *Evil*, it cannot be a double *Passion*, but only one, which executes both parts.

The causes of this *Passion* are the *Animal Spirits*, which pass from the *Heart* to the *Brain*, and seem to cherish and preserve the *Image* there first impress'd. For as soon as the *Soul* hath a *Will* to acquire some *Good*, which is grateful to it, or to remove some *Evil*; immediately it Transmits the *Spirits*, by the help of the *Glandule* to all parts of the *Body*, especially to the *Heart*, that, so much the greater plenty of *Blood* as is received within its Cavities, so much the greater quantity of *Spirits* may be conveyed to the *Brain*, as well to conserve, and corroborate therein the *Image* of the *Will*, as to move those *Muscles* that are necessary for the gaining of that which is desired; whence it comes to pass, that when the *Mind* desires any thing, the whole *Body* is rendred more *Agile*, and becomes more chearful to execute all the offices of the *Body*, than at other times it uses to be; namely, because the *Heart* being more vehemently agitated, supplies the *Brain* with the more *Spirits*, which taking their course thence to the *Muscles*, cause the *Senses* to become more vivacious, or the *Members* of the *Body* more disposed to motion.

To *Cupidity* or Desire, as hath been said, are reduced *Hope*, *Fear*, *Jealousy*, *Security*, *Desperation*, *Fluctuation* of *Mind*, *Animosity*, *Boldness*, *Emulation*, *Puillanimity* and *Consternation*.

Hope is a disposition of the *Soul*, produc'd by a special motion of the *Spirits*, to believe that that will come to pass, which it desires. So that no *Object* can stir up *Hope*, unless it be represented to the *Mind*, as easie to be obtained.

Fear, is another disposition of the *Mind*, by it persuades it self that that which it desires, will not come to pass: These two *Passions* however they are oppos'd, may nevertheless be found in the same, and at the same time, namely, when any one is perswaded by different *Reasons*, by some, that the *Object* he desires may be easily, by others, difficultly acquir'd.

Jealousie, which is referr'd to *Fear*, is the Fear of losing a good which we greatly esteem, proceeding from the least causes of suspecting; or when led by suspicion only, we fear to lose a certain good.

Fluctuation

III.
The Difference between aversing Evil, and desiring Good.

IV.
This Passion is produc'd by the Animal Spirits.

V.
The several species of Cupidity.

VI.
The Definition of Hope.

VII.
Of Fear.

VIII.
Of Jealousie.

Book 1. Part 9. Chap. 11.



G. Freeman. Inv.

J. K. Sculp.

To the Worshipfull
of Eye in Here=



Henry Gorges
fordshire Esq^r

This Plate is humbly

Dedicated by Richard Blome.

Book. 1. Part. 9. Chap. 12.



To the Worshipfull
the Inner Temple
Judges of the Sheriffs



James Mundy, of
Esq. one of the
Court London.

This Plate is humbly

Dedicated by Richard Blome.

IX.
Of Fluctuation of Mind.

Fluctuation of Mind, is the Fear of Erring in the choice of things, which tend to constitute the end, which while it retains the Soul in doubt, and suffers it not to perform one action more than another, causes it to perform none, and consequently hath a sufficient time left it to determine before it makes choice of any thing: Which Passion is so prevalent in some Persons, that oftentimes when there is no need of deliberation, in the thing designed, nay when it is the only thing to be omitted or performed; yet nevertheless, they remain in such suspense, that they are altogether incapable of inquiry into other things.

X.
Of Animosity, Boldness and Emulation.

Animosity is some certain Heat or Agitation, which disposes the Mind to act stoutly in the performance of those things which it designs. If any great danger attend the said things, it is called Boldness, which disposes the Soul to act those things, on which some great and imminent danger is attendant. Emulation, which is a certain Species of Animosity, arises from the consideration of other Men's success: Because when we see other Mens undertakings happily succeed, we are commonly moved by their Example to set upon the same thing, and in our Acting to Trace the same Footsteps as they have done. And this happens while the Body is so disposed, that Cupidity and Hope, have more strength to impel the Blood copiously into the Heart, than Fear and Desperation have to hinder it.

XI.
Of Pusillanimity and Consternation.

To Animosity, Pusillanimity is directly contrary, and it is a Languor or Coolness which hinders the Soul from going on to execute those things, which it would certainly execute, if it were destitute of the said Coolness. And Consternation, which is opposite to Boldness, is joyn'd not only to the Cold, but also to the Stupidity and Perturbation of Mind, which disarms it of its Power and Ability, to oppose its self against those Evils which it expects, and thinks to be at hand.

CHAP. XII.

Of Joy.

I.
Gladness is the Term or Bound of all Affections.

Gladness or Joy may be called the Term or Bound of all the motions of our Soul; which as they begin in *Admiration*, so they cease or terminate in *Joy* as in their own proper Scope or Aim: For desire of *Good* ceaseth in the obtaining of *Good*, and all inquietude is removed from us, as soon as we possess those things which we so greatly desired. In present *Joy* *Fear* ceaseth, *Sadness* is banisht, *Desperation* is destroyed, *Love* is at rest, and the rest of the *Affections* vanish, whilst we are wholly taken with *Joy* or *Pleasure*.

II.
The Definition of Joy.

Gladness or Joy is a pleasant commotion of the Soul, in which the possession of that Good consists, which the impressions of the Brain represent to it as its own. We say, that the possession of Good consists in a pleasant commotion of the Soul, in regard it is as it were the only Fruit of all the Goods it has, which being taken away, it can no more be said to enjoy them, than if it were totally deprived of them. To which it is properly added, that that Good, by the impressions of the Brain, is represented to the Soul as its own: That Joy, which is a Passion, may the more easily be distinguished from that which the Soul experiments by

Action, which that they may not be confounded, it will not be from the purpose to observe the Nature of each.

For *Joy* is twofold, one *Sensual* or which so depends upon the *Body* as to make it its principal Object, the other *Intellectual*, which is a pleasant commotion of the *Soul*, springing from a clear and distinct knowledge of the *Good* which is apprehended: Which distinction is hence understood, namely, because the *Intellectual Joy* may sometimes be without the *Sensual*, as when from any good *Action*, we feel a satisfaction from that pure consideration that we have performed our *Duty*; altho' it be difficult to experiment it, so long as the *Soul* is in the *Body*, since the *Intellectual Joy* makes always some impression upon the *Body*, such as is required to the framing of a *Passion*, for there is so streight a Union between our *Soul* and *Body*, that tho' the *Good* which the *Soul* is sensible of belongs not to the *Body*; yet *Imagination* always fains some *Idea* in the *Brain*, from whence there follows a motion of the *Spirits*, which produces the *Passion* of *Joy*.

The cause of this *Passion*, as may be gathered from its *Definition*, is the possession of some *Good*; for then the *Soul* seems to be satisfied, when it enjoys that thing which it esteems to be its own *Good*, and to conduce to its *Felicity*; tho' it often happens, that we find our selves overjoy'd, and wrapt up in I know not what kind of *Pleasure*, when the cause of this change is utterly unknown: As when our *Body* is cheerfully dispos'd, and with great alacrity performs its offices, but this proceeds from hence, namely, that the *Good* impresses some *Idea's* in the *Brain*, without the help of our *Soul*: That is, when the constitution of the *Brain* is such, that the *Animal Spirits* may the more easily be brought down into the *Nerves*, as well those which serve for dilating the *Orifices* of the *Heart*, as others. So when the *Heaven* is somewhat more than ordinary *Serene*, we feel a kind of *Hilarity* or *Cheerfulness* in our selves, which proceeds from no *Function* of the *Intellect*, but only from the impressions, which the motion of the *Spirits* excites in the *Brain*.

The *Internal Causes* of this *Passion* are the *Blood*, and motion of the *Spirits*, not so much in the *Nerves* of the *Stomach* and *Intestines*, as in *Love*, or of the *Milt* and *Liver*, as in *Hated*, as in those which are spread through the rest of *Body*, those especially which are about the little *Mouths* of the *Heart*. In regard they by opening and enlarging afford a way to the *Blood*, which other *Nerves* propel from the *Veins* to the *Heart*, that it may go in and out in greater plenty than usually; but because the *Blood* having many times before entred the *Heart*, and so flowing out of the *Arteries* into the *Veins*, is thereby more subtilized, it thereupon becomes the more easily rarefied and creates *Spirits*, which by reason of their equality are adapted for the forming and corroborating impressions of the *Brain*, which supply the *Heart* with joyful and serene *Cogitations*; whence it happens that so long as the *Soul* is affected with *Joy*, the *Pulse* of the *Arteries* is equal, and more quick than usual; moreover a certain grateful *Heat* is felt, not only in the *Breast*, but also in the *External* part of the *Body*, into which together with the *Blood* it is copiously transmitted.

III.
Joy is twofold Sensual and Intellectual.

IV.
The External cause of this affection is the possession of a Good.

V.
The Internal causes are the Blood and motion of the Spirits.

The

VI.
The various effects
of Joy.

The most noted instance of *Joy*, and which is commonly observed in those that are therewith affected, is a *Lively Colour*, and generally ruddy, which it paints in the *Countenance*, and which hence proceeds, namely, that *Joy* dilating the *Fibres* of the *Heart*, causeth the *Blood* more copiously to enter into the *Heart*; and being there more intensely warmed to be distributed the sooner into the *Veins*; and by this means excites a grateful and lively *Colour* in the whole *Body*, especially in the *Face*: Moreover, in the same affection of *Joy*, the *Spirits* happen to be so disposed; as that those which flow into the *Muscles* of the *Face* and *Breast*, make such a concussion of them, as to cause *Cachinnation* or bursting into a strain of *Laughter*, which sometimes is so great, that by the force thereof, the passages of the *Eyes* being opened, *Tears* thereupon gush out: For *Tears* are nothing else but *Vapours*, which in their passage out of the *Eyes*, are turn'd to *Water* in the *superficies* of them, after the same manner, as was before declared, concerning the *Original of Fountains*.

VII.
Of Joy
there are
divers Species.

There are divers species of *Joy*, according as we consider the *Good* hapning to our selves, or the *Evil* to others. The first which offers it self is *Derision*, which hence hath its *Original*, viz. that we find some *Light Evil* in one, who is thought to deserve it. In which *Passion* there is mingled something of *Hatred*. As when we have an aversion to the said *Evil*; and yet nevertheless rejoyce to see it inflicted on him whom we think it but just it should fall upon. Those that are remarkable for any kind of deformity or defect of *Body*, are chiefly obnoxious to this *Passion*, as the *Gibbous* or *Bunch backt*, *Goggle-Ey'd*, *Lame*, who, in regard they are not ignorant of their being an *Object* of contempt and derision from others, rejoyce to find others in as bad circumstances as themselves; it being to them a solace of that *Grief*, which they suffer from the *Contumely* objected against them; so that they take the least occasion given to insult over them, and sport themselves with their defects.

VIII.
What Satisfaction
is.

Satisfaction or *Acquiescence* in ones self, is a *Joy* of all the most grateful, which proceeds from the *Opinion* of something done by us which we judge to be *Good*. Whence they who give themselves to *Vertue* and *Honest Actions*, feel, I know not what *Tranquillity*, of *Soul*, and *Quiet of Conscience*, which is the most pure and sincere of all satisfactions, because they depend upon those things which are in our power.

IX.
What Favour.

Favour is a *Joy* wherewith we are affected toward those that do well, and use their *Free-will* according to *Reason*. Since by a *Natural Impulse*, we are apt to *Love* those whom we judge to be *Well-doers*, tho' nothing of profit accrue to us thereby.

X.
What Gratitude.

Gratitude is a certain joyful desire of doing well to those who have deserved well of us. This Affection is peculiar to *Generous Souls*, who are never insensible of *Kindnesses*, but strive always to be requiters of *Benefits* receiv'd.

XI.
What Glory.

Glory is a *Joy* arising from *Opinion* or *Hope*, conceiv'd of obtaining praise among others. This *Passion* is founded upon *Self-love*, as when we value our selves according to the esteem we see set upon us by others.

CHAP. XIII.

Of Sadness.

GR I E F brings up the Rear of the Passions, the most common affection among Mortals, the Companion and Enemy of Joy. It seems to have been allotted by Nature for the Persecutor of Mankind, and lier in wait as well for Soul as Body. There is scarce any Sadness which does not transfer its force from the Soul upon the Body, and with one stroke hit two different things at once.

For Sadness is no other than a certain ungrateful Languor, or the Inconvenience which happens to the Soul, from the Evil or Defect which the Impressions of the Brain represent to it as its own. Which Definition extends only to Sensual Pains, as they differ from Intellectual. For no doubt, but sometimes, there may be Sadness in the Soul, tho' all Cause be removed which excites Corporal Pain, as appears in those who have a Limb cut off, who are not only affected with Sadness upon the loss of the said Member, but also long after when they look upon themselves as maim'd persons, and depriv'd of a part which conduceth to the gaining of a *Livelihood*. But in regard these sorts of Pain are seldom found, which are produc'd by an Action of pure Intellect; and whatsoever happens to the Soul, so long as it is united to the Body, is depainted forth by Imagination in the Brain, We only here treat of Sadness, as it is a Passion.

And it arises from from an Opinion of an adherence of some Evil or Defect; for the Body cannot be hurt, but the Soul must immediately be disturbed, and be sensible of a certain bitterness thereby. Tho' it sometimes happens, that we find our selves sad or dejected, when ignorant of any causes of the said dejection. As when the Body languishes, and is not able to perform its functions, when the Heaven is all over covered with Clouds, as it often happens in the Winter-time; because then the Nerves of the Body are not, as they us'd to be, agitated, and so remain, in a sort, immoveable.

Sadness arises when the Animal Spirits are so dispos'd by the Glandule to the presence of an Object of Sadness, that they streighten and contract the Orifices of the Heart by the Nervule wherewith they are encompassed, and hinder the Blood from its copious entrance into it, and egress out of it. Whence it happens that the Heart hath very little of Ardour and Inflammation, the passages in the mean time remaining open, through which the Chyle is conveyed from the Stomach and Entrails into the common Ocean, which is the cause of Appetites being diminish'd, unless Hatred supervening Sadness, which is oftentimes joyned to this Passion, closes and shuts them up.

Thereupon in persons affected with Sadness, the Pulse becomes weak and slow, and they seem to feel, as it were, Fetters about the Heart, which bind and restrain it like Icicles. Which frigidity being dispers'd through the rest of the Body, causes it to remain sluggish and unactive, and does also make those that labour under Sadness to grow pale, because by compressing the vessels of the Heart, it causes the Blood to flow the more slowly into the Veins; and so having less agitation than usual, it requires a less place to possess; so that betaking it

I.
Sadness an
Enemy to
Man.

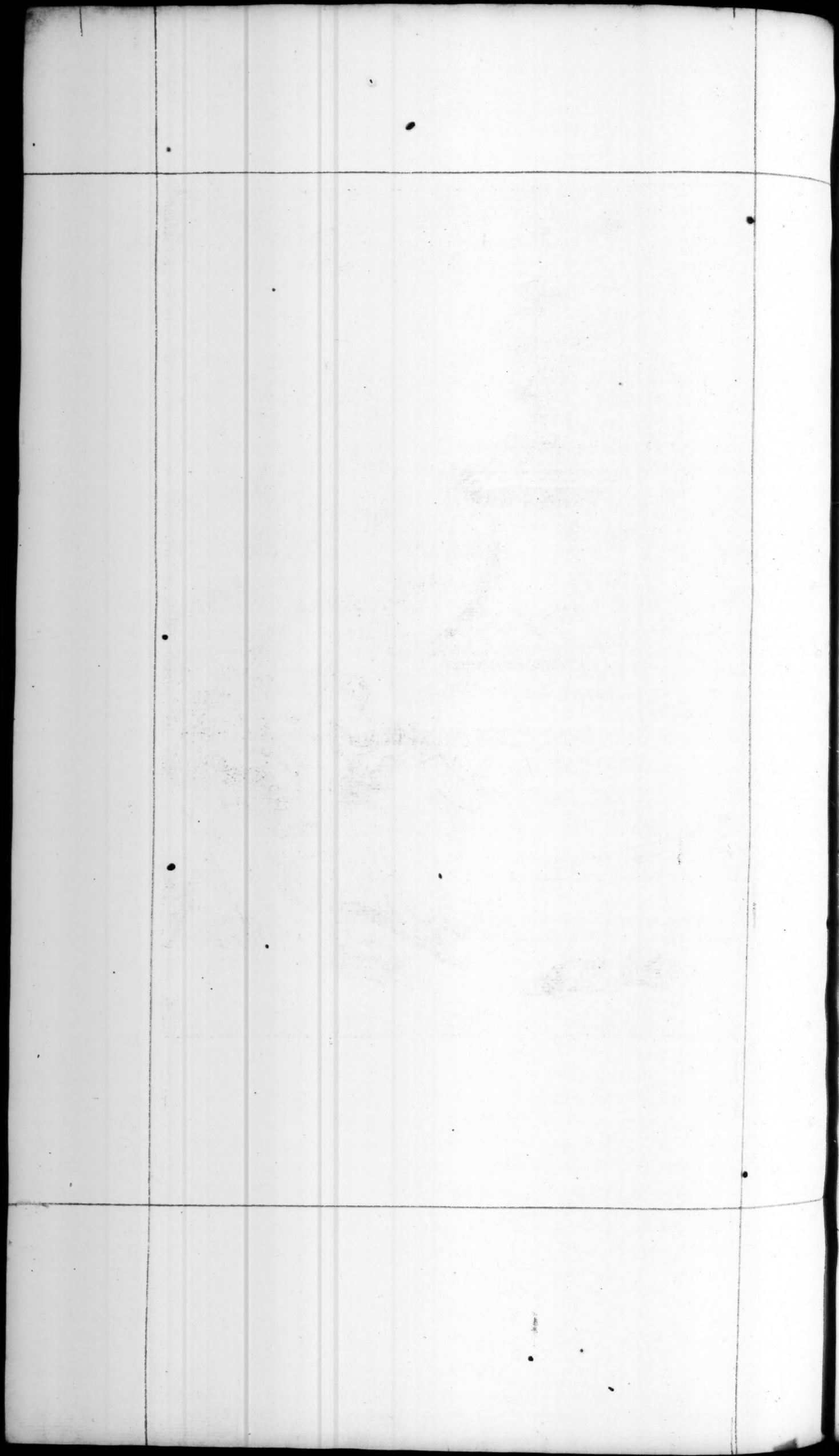
II.
The Defini-
tion of Sad-
ness.

III.
Whence
Grief arises.

IV.
The Inter-
nal Causes
of Sadness.

V.
Various Ef-
fects of
Sadness.





it self into larger *Veins* which are nearer to the *Heart*, it leaves the more remote; whereof those that are diffus'd through the *Face* are more conspicuous; and upon that occasion they are rendered more pallid. Nor is the cause very different of those *Tremours* which are incident to persons affected with *sadness*, in regard when the *Blood*, as hath been said, is languidly deduc'd through the whole *Body*, it must needs be but slowly convey'd to the *Muscles* of the *Arms* and *Legs*, so that the *Valvulae* are not straightly enough closed, which is the reason that the *Spirits*, swiftly taking their course through the *Connivent Ostioles* of the *Muscles*, produce *tremours* in the said members of the *Body*.

VI.
How Tears
are attend-
ant upon
Sadness.

Tears, as they accompany *Joy*, so also sometimes *Sadness*, and are produc'd, when upon the *Blood* being refrigerated by *Sadness*, the *Pores* of the *Eyes* are contracted, by reason of which compression the *Vapours* proceeding from them are converted into *Water*; that is to say, because their motion being retarded, their parts meet, and are so united one with another, that they end in *Tears*.

VII.
Evil, ac-
cording as
it is appre-
hended, ex-
cites vari-
ous effects
in us.

As *Evil* is an Object of *Sadness*, so it produces various effects in us, according as we refer it to our selves or others. For an *Evil* offered by us under the notion of an *Evil*, when we consider that we have committed it, excites *repentance*, which is so much the more bitter, in regard it depends upon our Free Will, and was in our power of committing or not committing that which so much aggrieves us. The *Remorse* of *Conscience* is a *Sadness* arising from a scruple or doubt, whether what we have done be good or not. In this *Passion*, *Dubitation* ought to be necessarily included; forasmuch as if what we commit should be manifestly known to be *Evil*, we should refrain from committing it, since our *Will* is never carried on, but to those things which are represented to us under some appearance of *Good*. And if that *Evil* which we commit, should plainly appear to be an *Evil*, we should then be toucht, not with a simple remorse, but with downright *Repentance*, which is the severest of all *Passions*. We are therefore toucht with remorse, because we attempted a *work* before we made any doubt of it, or shook off the scruple of *Mind* which attended it.

VIII.
What En-
vy produces

Envy is a species of *Sadness*, not simple, but mixt with *Hatred*; which proceeds from hence, namely, that we see a *Good* to befall others which we judge them unworthy of. This *Passion* extends not it self to all sorts of *Good*, but only those which we call the *Goods* of *Fortune*. For those things which are granted to us by *Nature*, seem to be above *Envy*. The *Envious* are for the most part of a *Livid Colour*, in regard *Sadness* operates upon the *Body* the same way as *Hatred*, causing *Choler*, which proceeds from the lowermost part of the *Liver*; as likewise *Melancholy* from the *Spleen*, to flow to the *Heart*, from whence diffus'd through the *Arteries* and *Veins*, they cause the parts of the *Blood* which is in the *Veins* to be less agitated; and this is sufficient to induce a *Livid Colour* upon the *Countenance*, provided it be copious and intense enough.

IX.
What Fa-
stidia is.

Fastidie or *Loathing*, is another sort of *Sadness* arising from the same cause from which *Joy* for-

merly arose; for we are of that *Humour*, that almost all things we possess, are valued by us as good, only for the time being, and are afterwards lookt upon as incommodious, which especially appears in *Eating* and *Drinking*, which never please but so long as the *Appetite* prevails, and are distastful when the *Appetite* ceaseth, and because they then cease to be grateful to the *Taste*.

Commiseration is a *Sadness* mixt with *Benevolence* or *Love*, proceeding from the consideration of some *Evil* which befalls those persons whom we think unworthy of it: And is in some so vehement, that it draws *Tears* from their *Eyes*, by reason that at that time, through the *Affection* of *Love*, a great quantity of *Blood* is propelled to the *Heart*, from whence many *Vapours* being emitted to the *Eyes*, and having their motion retarded with cold, are, as hath been several times already intimated, changed into *Tears*.

Indignation hath a great affinity with *Hatred* or *Aversion*, wherewith we are naturally stirr'd up against those that do ill. It is very often join'd with *Envy* and *Commiseration*, and the difference lies chiefly in the Object. Forasmuch as we envy those to whom any thing of good happens, and are fellow-sufferers with those that suffer ill undeservingly. But our *Indignation* is against those only who do good turns to those that are unworthy of them.

Anger, which may be referred to *Indignation*, is the *Aversion* against those who have offered any ill, or at least have design'd any *Injury* to us. This *Anger* is always attended by a delire of *Revenge*, which is the most impetuous of all *Affections*; in regard the *Hatred* which is found in it, causes the *Bilious Blood*, which flows from the *Milt*, and from the little *Veins* of the *Liver* to undergo a very great *Agitation*; which *Blood* entering the *Heart*, stirs up an extraordinary *Heat*, which is far more rigid and vehement than that which proceeds from *Love* or *Sadness*.

There are two sorts of *Anger*, one very quick, and soon breaking forth, and disclosing it self in the *Countenance*; but this is of little effect, and with small labour allay'd: The other is not so soon discharged, but inwardly afflicts and stings; and the effects of this are much more dangerous than those of the former. To the first, those are *Obnoxious*, who either *Love*, or are indued with a good *Nature*; by reason that this sort of *Anger* proceeds not from *Hatred*, but from a sudden *Aversion* which hastily seizes them; because those things which they think of, fall not out in the same manner as they imagin; whence it happens, that as soon as they come to consider that those things which so moved them, ought not to have stirred them up to *Anger*, they are toucht with shame and *Repentance*, and condemn themselves for their rash and unseasonable *passion*; whereas those that are affected with the other sort of *Anger* are more to be fear'd, discovering no other colour in their *Face*, but a pallid Hue, in regard the heat being drawn back to the *Heart*, they reserve themselves for *revenge*, and think of nothing but the time of *Vengeance*, and those circumstances which lead thereunto: This is a *Vice* peculiar to *Persons* of a *Base* and *Abject Spirit*.

Shame is founded upon *Self-love*, which proceeds from *Opinion* or *Fear* of *Dispraise*. *Desire*, if

X.
The Effect
of Commi-
seration.

XI.
The Ef-
fects of In-
dignation.

XII.
Of Anger.

XIII.
A Twofold
Anger.

XIV.
What
Shame is,
and Desire.

S f f f

if it be more strictly inquired into, than commonly it is in *Schools*, is a certain sadness for a *Good* lost, and whereof there is no hope of recovery : For we are never afflicted with *Desire*, except for the loss of *Goods* sometime possessed, and which we imagin so snatcht from us, as to be left without any hope of ever obtaining them again.

CHAP. XIV.

Whence the Natural Inclinations and Aversions of some Men arise.

I.
Various Inclinations are found in Men.

HAVING treated of those *Passions* of the *Soul* which are common to all *Men*, and which presuppose a Connexion of the *Body* and *Soul* ; it remains that we say something of the *Inclinations* of some *Men*, which are peculiar to themselves, and which have the *Body* only for their *Principle*. For there are found in some *Men* certain *Affections*, which are by Nature implanted in them, by which they incline to some things with a wonderful Ardour of *Desire* ; and are so abhorrent of others, as not to be able to indure the sight of them. So some *Men* have certain *Meats* in very great esteem and delight. Others on the contrary, have as much aversion to one thing or other : Many cannot endure the sight of a *Cat*, or the very presence of it in the same *Room*, tho' they see it not ; some cannot abide the smell of *Roses* ; and so for other things some have a *Love*, others an *Aversion*, of which neither can give any account.

II.
Antipathy and Sympathy are only words in the Schools.

It is a common thing in *Schools* to have recourse to the words *Sympathy* and *Antipathy*, and thereby to pretend to give an account of *Passions*, which indeed they are wholly ignorant of, by saying that these things so happen, because there is a certain *Agreement* or *Enmity* in *Natural things*, by which they either *Love* or *Hate*. But this way of *Philosophizing* may be compared with a certain design or project for a piece of *Painting* ; as if any one should go about to give directions with a *Pen* and *Ink*, how the *Sign* of a *City* were to be *painted*, in what part of the *Country* the *City* was situated, what *Posts* were chiefly possessed by the *Besiegers*, where the *Enemies* planted their *Scaling-ladders* to get over the *Walls*, how the *Engines* broke the *Gates* asunder, where the *Pioneers* sprung their *Mines*, with what *Arms* the *Besieged* defended themselves, and where they made their *Sallies* ; but after all should leave the whole Draught and Colouring to the Art of the *Painter*, yet nevertheless should take upon him to be the Author of this *Picture* of the *Siege*, to which he had contributed nothing but *Names*. So to assert that any thing is effected by a certain *Virtue*, and not to declare after what manner it is done, is to my apprehension the same thing as to confess ingenuously, that he is totally ignorant of the matter discours'd of.

III.
If a Corporeal Action be joyned to any Cogitation, we cannot remember the one without the other.

Therefore some other way must be tried for the finding out of these *Occult Inclinations* or *Qualities* which are observed in some *Men* ; which may easily be effected, if we consider but two things ; First that there is such a connection of *Soul* and *Body*, that when once we have joyn'd any one *Corporeal Action* to any *thought*, never after any one of them manifests it self, but the other attends

it ; as we may observe in those persons, who being sick, have drunk up any *Potion* with much distaste and reluctance, that they cannot afterwards feed upon any *Meat* or *Drink* that hath any thing of the relish of the said *Potion* ; but that the *Stomach* must needs have an aversion to it ; nay, cannot so much as remember that *Aversion*, but that the same *Savour*, which sometime offended the *Tongue*, must return into the *Mind*.

Secondly, observe that it is not always of necessity that the same *Actions* of the *Body* be joyn'd to the same *thoughts*. For those that speak *English* utter their conceptions by some certain words different from those by which the *French* express their *cogitations*, yet they both mean the same thing ; for no otherwise is *DEUS* conceived by an *English* Man, under the word *GOD*, than by a *French* Man under the word *DIEU*, both of them understanding the same thing, tho' by two different appellations : For as often as an *English* Man hears the Name of *GOD*, he presently apprehends thereby an *Infinite, Eternal, Almighty Being*, &c. the same doth a *French* Man when the sound of the word *DIEU* comes to his Ear.

These things thus briefly noted, any one may easily give an account of all those matters which he finds particular either to himself or others. The *Aversions* which are observed in some men, against some things, hence proceed, namely that, in the beginning of their *Life*, they have been hurt or offended by them : So the smell of *Roses*, might possibly have given to an *Infant*, while yet in the *Cradle*, some great Offence, or a *Cat* might have affrighted him, without any ones taking notice thereof, or the Party's retaining it afterwards in *memory*. Some *Aversions* also are produced in us before we are *born*, since certain it is, that the *Motions* of the *Mother* have a very great influence upon the *Motions* of the *Child* in the *Womb*, so as that whatever is hurtful to the one, is also hurtful to the other. Thus *James I.* King of Great Britain, had so great an *Aversion* to drawn *Swords*, that he could not behold them without a world of *horror*, which is thought to have thus affected him, by reason that his Mother *Mary*, Queen of Scots, when she was great with *Child* of him, was frighted at the sight of a *Sword*, wherewith in her *Bed-Chamber*, and before her *Face*, in a barbarous manner, one of her *Courtiers* was stabb'd to death.

'Tis true, that it is no easie matter to determine the cause of this *King's Horror* upon the said occasion, since it is hard to conceive how the *Image* of the thing which was only transmitted through the *Eyes* to the *Mothers Glandule*, could light upon the *Glandule* of the *Infant*, whereas, as for other things, as the *Odour* of *Roses*, or the *Savour* of *Meat*, it may be aply enough made out, since the *Odour* of the *Roses*, and the *Savour'd Aliment* might easily through the *Pores* of the *Mother*, reach to the *Infant*, since it is nourisht by the *Mother*, and both have a communion together by the *Navel String*. Yet it may be said that that *Aversion* in the *King*, might happen to him by the *Mothers Eyes*, because at the presence of so horrid an *Object*, a Notable Mutation might be made in the *Mothers Animal Spirits*, by which the *Infant* she carried in her *Womb* was offended,

IV.
Sometimes it may be, that the same thing may be effected, yet the Actions of the Body not be the same.

V.
When Natural Aversions arise.

VI.
How it came to pass that K. James I. so much abhorred the sight of a drawn Sword.

offended, by reason of the mutual Relation between the *motions* of them both.

VII. *Imagination alone can beget such over-sensations.*
 Besides, there is not an absolute Necessity that the *Object* should be always present to our *Senses*, for the exciting of any *Passion* in us, since that can be effected by *Imagination* alone. For an *Impression* through the *Arteries* of a *Woman* with *Child*, may arrive to a certain part of the *Birth*, and there produce some *Marks* thereof. Whereupon it happens, that those *Women* who transgress their *Nuptial Faith*, and prostitute themselves to other *Men*, many times bring forth *Children* like to their *Husbands*; namely, because the fear of being surpriz'd by the sudden arrival of their *Husbands*, causes them to have the Presence of their said *Husbands* perpetually represented to their *Imagination*, as hath been observ'd in the 9th Book of our *Natural History*, in the Chapter of *Imagination*.

VIII. *Why of two Men be beheld, we love one more than another.*
 There seems yet to be a greater Difficulty, how to give an account, why of two *Persons*, whose *Merits* are equally unknown, we incline to *Love* one more than another. But this will not be any great Miracle, when we seriously consider that the *Objects* which affect our *Senses*, move certain Parts of the *Brain*, by the help of the *Nerves*, and make *Pleits*, which, without any farther concern of the *Object*, vanish; yet so, as that the part in which they had been receiv'd, remains dispos'd for the receiving of *Pleits* from any other *Object*, which have any Similitude with the former. So when yet a *Child*, languishing with a long *Diltemper*, and given over by the *Physicians*, I fell into the hands of a certain *Woman*, by whose Care and Industry recovering my *Health*, I contracted so intimate a Friendship with a *Son* of hers, that I could scarcely be divided from his Company, without much Regret and Impatience: Yea, after some Months, being carried home to my *Parents*, I perpetually languish'd with a desire of this my *Little Companion*; nor put I any end to my *Tears*, till such time as he was restored to my Society. And when a few Months after, it pleas'd *GOD* to take him out of this *Life*, I continued to bear a singular Affection towards all *Boys* whatsoever, that resembled him in *Countenance*; and to this very day preserve the same Affection to *Children* of the like Resemblance.

IX. *This Disposition is induc'd from Objects by the Senses, or from some other Cause.*
 In like manner, when we *Love* any *Body* for any hidden Cause, it is more credible that it hence proceeds, namely that there is something in him, like to those things which were formerly in some beloved *Object*, tho' we know not what it is. And though doubtless that which thus allures our Affection, is oftner a *Virtue* than a *Vice*; yet nevertheless, in regard it may sometimes so happen, that it may be a *Vice*, no wise *Man* ought to indulge to this sort of Affection, till such time as he hath well weigh'd the Merit of that *Person*, with whose Presence or Concernment, he finds himself so affected. *DES CARTES*, when a *Child*, as he himself writes to *CHANUTE*, loved a little *Girl* of the same Age with himself, that was *Squint-Ey'd*; and by this means the *Impression*, which through the Sight was received in his *Brain*, was so joyned to the *Impression* which was also made in him, to move the *Passion* of *Love*, that even a long time after, as often as he lighted upon any who had the like sort of *Eyes*, he found himself propense to *Love* them above others, and

for this very thing, because they had that *Imperfection*; yet did he not know that this was the Cause of his *Love*. On the contrary, from the time that revolving with himself, he apprehended this *Blemish* to be an occasion thereof, he was no longer affected by it.

CHAP. XV.

Of the Immortality of Human Mind, and of its State after Death.

THAT *Human Mind* is incapable of *Death* and *Destruction*, its *Nature* and *Functions* clearly demonstrate: For whereas it is evident from what hath been often said, that the *Soul* is a *Spiritual Essence* and separate from all *Matter*, it must consequently of necessity be free from all *Destruction* and *Corruption*; since nothing but what is *Concrete* and *Compound* can be separated, divided, or taken asunder. For *Destruction* is, as it were, a *Separation*, *Dividing*, or *Parting* asunder of those *Parts*, which before the said *Destruction* were held together, as it were, by a certain Link or Tye.

Nor do the *Functions* of the *Soul* less argue its *Incorruption*, as being Effected by no *Organ* of the *Body*, as is sufficiently made out almost throughout this whole *Work*; forasmuch as it forms and proportions the *Universal Natures* of things abstracted from *Matter*, which cannot be the *Work* of a *Corporeal Faculty*. For a *Power* or *Faculty* subjected to a *Material Organ*, receives the *Qualities* and *Forms* of things after a certain *Corporeal manner*. What therefore comprehends *Forms* in a *Spiritual manner*, uses no *Instrument* of the *Body*. Neither indeed are the *Principles* impress'd upon the *Mind*, or the *Rudiments* of *Cogitation* assign'd to our *Intellect*, *Mathematical Demonstrations*, or *Certain* and *Fix'd Judgments*, any *Corporeal Acts* or *Productions* of *Imagination*. But nothing *Incommutable* or perfectly *Single*; nothing *Eternal*, nothing *Universal* and *Abstract* is perceived by the *Power* of *Imagination*; whereas all *Bodies* are subject to *mutation*, *place*, and *time*.

Now the better to support this *Verity* with *Reasons*, we must suppose, that of those things which perish or cease to be, some are *Simple*, and some *Compound*. The *Compound* are said to lose their *Existence*, when the *Parts* which concur to their Composition are separated from each other. As a *Man* is said to Cease, when *Soul* and *Body*, of which he is compos'd, are separated. Whereas the *Simple* can no other way cease to be, but by *Annihilation*, as they could no other way be produc'd but by *Creation*. And since *Creation*, as also *Annihilation*, are both beyond the power and ability of *Nature*, they can no way be destroy'd by any *Creature*. But it is evident, that the *Soul* is a thing purely *Simple*, since it is the only *Subject* that entertains *Cogitation* or *Thought*, together with the various *Modes* of *Cogitation*, and consequently the Capacity of being destroy'd, is *Naturally* repugnant to it.

And this will appear more evidently, by comparing the *Soul* with the *Body*. Certain it is, that the *Body*, which gives place in dignity and perfection to the *Soul*, is not reduc'd to *Nothing*, when the *Soul* is separated from it: How therefore can the *Soul*, which is more noble and more perfect

I. Human Mind being Spiritual, cannot be destroyed.

II. Which is also made evident from its Functions.

III. How Compounds and Simples are said, to lose their Existence.

IV. Since the Body perishes not, much more must the Soul have be an Existence.

be thought to be annihilated when the *Body* is separated from it? Since indeed, no Reason can be brought for the duration of a *Material Substance*, which may not, by a more forcible Right, be apply'd to *Human Mind*. If we have recourse to the Evidence of *Sense* for the Consistence of *Body*, it cannot be maintain'd of all its Parts, since very many of them, into which it is resolv'd, are undiscernible to our *Senses*. Neither is the perception of our *Senses* so efficacious a means to demonstrate the *Existence* of *Bodies*, as the Reasons henceforth to be produc'd, are for asserting the *Immortality* of the *Soul*.

V.
Human
Mind can
be destroy'd
by no Cre-
ated Being.

If it be Objected, That *GOD* by his Power can annihilate all *Souls* whatsoever, and that it is through his Preservation alone that *Souls* are said to be *Immortal*. This we are ready to confess, as acknowledging that *GOD* alone is a Being wholly *Independent*, *Eternal*, *Necessary*, &c. and that there is nothing Existing in *Nature*, but only so long as he pleases. So that we have nothing now to do, but to make it out plainly, that *Human Mind* is of such a Nature and Quality, that it cannot be corrupted or destroy'd by any *Created Being*, which is a sufficient Ground for it to be call'd *Immortal*. For it being Undeniable, that *GOD* is all *Wise*, all *Good*, and all *Constant*; and *Human Soul*, the Noblest *Workmanship* of so great a *Maker*, and the *Image* of him: Who can imagin or believe, but that it must needs be far from the *Mind* of so *Wise* and *Constant* a *Maker* to Create so *Glorious* a *Work*, and afterwards to destroy it? True it is indeed, and not to be gain-said, that *GOD* by his extraordinary Power, can destroy the *Human Soul* consider'd, according to its absolute *Esse* or *Being*: But it is repugnant to Reason, that he should destroy it by his ordinary Power, which is sufficient to make the *Soul* *Immortal*. For when we treat of the *Immortality* of the *Soul*, the Question is not, Whether *GOD*, by his Extraordinary Power can destroy it; but whether it can be destroy'd by *Natural Causes*, and by the ordinary Power of *GOD*.

VI.
The Cor-
ruption
of the
Soul, follows
not from
the Cor-
ruption of
the Body.

Moreover, when a *Man* dies, *Death* happens to the *Body* upon this occasion only, namely, because some of its Parts are divided, and its figure changed. But the division of *Members*, or change of *Figure*, no way concern the *Mind*, in regard it is indivisible, and affected with no *Figure*. Who therefore can believe that the *Soul*, which is *Inextense*, can, for so slight a Cause, as is the Change of the *Body*, perish or be annihilated? In the next place, this sort of *Annihilation* hath not yet been found in *Nature*: Nor can it be made out by any *Argument* or *Example*, that *Substance* can perish. Wherefore, seeing that *Human Mind* is a *Substance* Independent of the *Body*, and not any way subject to the Mutations which are made in it, we conclude, that it may Exist separated from it, and by consequence, that it is *Immortal*.

VII.
There is no
Cause ca-
pable to
destroy a
separate
Soul.

As to what some say, That hence may indeed be infer'd, that the *Soul* may possibly subsist separate from the *Body*; but that it will not last so *Eternally*. To this I Answer, that admitting one, the other must of necessity follow, in regard no Cause can be assign'd, which can destroy it in its state of Separation, since at time it is free from Matter, which alone is obnoxious to Change.

I know that there are many *Arguments* heap'd up by *LUCRETIUS* against the *Immortality* of the *Soul*. But they are of no weight against those who distinguish *Soul* from *Body*, and assign them contrary *Functions*. For if the *Soul* seem to be affected with the Diseases of the *Body*, to be disturb'd in immoderate Drink, *Epilepsy* and *Phrensie*, to be as it were lost in swooning Fits. This happens, because it is joyn'd to the *Body*, and makes use of it as its *Instrument* in performing most of its *Actions*. For as a *Scribe* furnish'd with a well-made *Pen* makes neat *Letters* or *Characters*; but that *Pen* being worn out with long use, he can no longer Cut his *Letters*, as before: So the *Soul* lighting upon a weak and infirm *Body*, ceaseth to perform its wonted Office, and remains as it were benumb'd, sluggish and altogether unactive.

This change therefore is not to be imputed to the default of the *Soul*, but of the *Body*, by whose help, so long as it is tyed thereunto, it operates. So that in a *Phrensie* or *Lethargy*, it is not the *Soul* which is distemper'd, but the *Brain*: The *Instrument* fails, so the *Functions* are at a loss. In like manner *Drunkennes* is not to be attributed to the *Soul*, but to the *Body*; forasmuch as the *Brain* being unloaded of its *Vapours*, the *Soul* is recover'd and comes to it self again, and performs its Offices, as before.

But the state of the *Soul*, after its Departure from the *Body*, is altogether unknown to us, since it wholly depends upon *GOD'S* good Pleasure; nor can we know, but by Conjecture, how it will then use its *Faculties*. It is but a rash Conceit in those, who ascribe such Perfections to it, as they are uncertain of, and measure its Felicity by their groundless *Apprehension*, since without *Revelation* we can have no assurance thereof, except that it follows necessarily from its Nature: Only thus much we may know, viz. that it will be *Immortal*, by reason that since it is a *Substance* distinct from the *Body*, its destruction follows not from the dissolution of its *Mate*, so that it will always persevere in its Nature, that is, will always Think.

We may likewise know, that it will have no commerce with *External Objects*, and that nothing of *Body* whatsoever can act upon it, because only its Union with the *Body* renders it capable of receiving the *Species* and *Actions* of *Objects*; so that it must needs be depriv'd of all *Sensibility*, and be destitute as well of *Memory*, as *Imagination*, in regard those things depend of the *Body*, and are chiefly conducive for the safeguard and knowing of the State thereof. Altho' it is not to be denied, but that it will perceive many *Objects*, by the force of *Intellect*, which will render their *Notions* more distinct and clear, than those which it had, when it was conversant in the *Body*. And there will be no Obstacle, but that the *Soul* may reproduce those *Notions* of things, which it had in this *Life*; by which it will come to pass, that it may the more easily remember them, forasmuch as it will occur to it, that once it had them.

So that in regard no *Bodies* can any longer act upon it, there will be an evident consequence, that in that State and Condition, it will be absolute Mistress of its own Thoughts, and will not think, but

VIII.
Arguments
of Lucre-
tius against
the Souls
Immorta-
lity.

IX.
Diseases
are not to
be attri-
buted to
the Soul,
but to the
Body.

X.
The State
of the
Soul, after
its Depart-
ure from
the Body is
unknown.

XI.
The Soul
after
Death, will
not be sen-
sible, nor
remember.

XII.
The Soul
will more
clearly
know Ob-
jects.

but of such things as its own Will and Pleasure shall be to think of; except by chance the *Almighty Maker* of All things, or other *Minds* or *Intelligences* with which it converseth, create a new *Thought* in it. But so long as the *Soul* is separated from the *Motions* of the *Body*, and nothing hinders, but it may remain employed in its own *Cogitations*, it will the more diligently, and with greater attention perceive things Objected to it, and will the more acutely advance in *Sciences*.

XIII.
Will every
where
accompan-
ies the
Mind.

The like may be said of the *Soul's Will* and *Faculty* of disposing it self. By reason that when it shall be free from all *Commotions*, to which before, because of its *Commerce* with the *Body*, it was obnoxious, it will with the greater liberty execute its own own *Affairs*, and will the more easily expel the *Doubts*, which are an *Obstacle* to its *Determination*. Yet of it self it will not be altogether free from *Errour*; because in regard its *Intellect* is *Finite*, and penetrates not into all things, it may be deceiv'd in its *Perceptions*, tho' it be not so prone to *Errour* as before. Forasmuch as being no longer possess'd by any *Prejudices*, and being free from *Affections*, it will the more easily gain this *Point*, not to be obliged to give assent to those *Things* which it knows not clearly and distinctly, and by this means it will be less liable to *Deception*.

XIV.
It is Doubt-
ful whe-
ther the
Mind can,
after Sepa-
ration,
move ano-
ther Body.

But it is not so apparently determin'd, Whether the *Mind* will, after the said *State of Separation*, retain the *Power* which before it had of moving a *Body*; since indeed such a *Faculty* doth not necessarily follow the *Nature* of a *Finite Being*, neither indeed is the said *Faculty* granted to its *Will*, except so far as it hath pleas'd its *Maker*, that is, so far as he hath *Decreed*, that its *Moving Power* must depend upon his *Will*. But since it highly conduceth to the extolling the

Clemency of *Almighty GOD*, that his *Works* should be manifested to his *Creatures*; it is most probable, that he will conserve this *Moving Power* in *Souls*, and give them *Capacity* to joyn their *Cogitations* at pleasure to certain *Bodies*, and in such a manner, as it shall desire to move and know them.

As the *Mind* or *Soul* is all *Spirit*, it will no more after *Separation* be capable of *Joy* or *Pain*, according as they sprung from the *Affections* of the *Body*; but only of *Joy* and *Pain*, which proceed from the *Intellect*. But if ever the *Mind* chances to suffer any thing from a *Corporeal thing*, it must be acknowledged, that it must consequently of *Necessity* be *United* thereunto by the *Divine Power*, as it was upon *Earth*; so as that its *Cogitations* must be connex'd to the *Motions* of the said *Body*, and according to the *Measure* of that *Impulse*, it must suffer from it more or less. And upon this account it is not improbable, but that the *Fire of Hell* may act upon the *Body* of the *Damned*.

XV.
The Soul,
after Sepa-
ration, will
be capable
of no Pain,
as from
the Body.

Other things which are attributed to the *Soul*, after its *Departure* from the *Body*, are uncertain and altogether depend upon the *Goodness* and *Mercy* of *Almighty GOD*, whose *Arcana* or *Secret Counsels*, to go about to search into, is both *Rash* and *Profane*. Hence it is that our *Illustrious Philosopher*, in his *Epistle* to the *Princess Elizabeth*, thus utters his *Mind* about the *State* of the *Soul* separated from the *Body*. But as to the *State*, saith he, of the *Soul*, after this *Life*, I know far less, than Sir KENELM DIGBY: For omitting those things which *Faith* instructs us in, I confess indeed, that we may *Conjecture* many things by the meer *Dint* of *Reason*, upon which we may sufficiently flatter our selves, and build mighty *Hopes*; but can gather nothing of *Certainty*.

XVI.
Other
things are
hid from
us, except
what is
revealed
by Faith.

T r r r

The

The Tenth Part
OF THE
INSTITUTION
OF
PHILOSOPHY.
VIZ.
ETHICKS,
Or, The Right way of Ordering the
LIFE of MAN.

A PREFATORY Discourse.

Of the Dignity and Use of Ethicks.

I.
The Dignity
of
Ethicks
above other
Sciences.

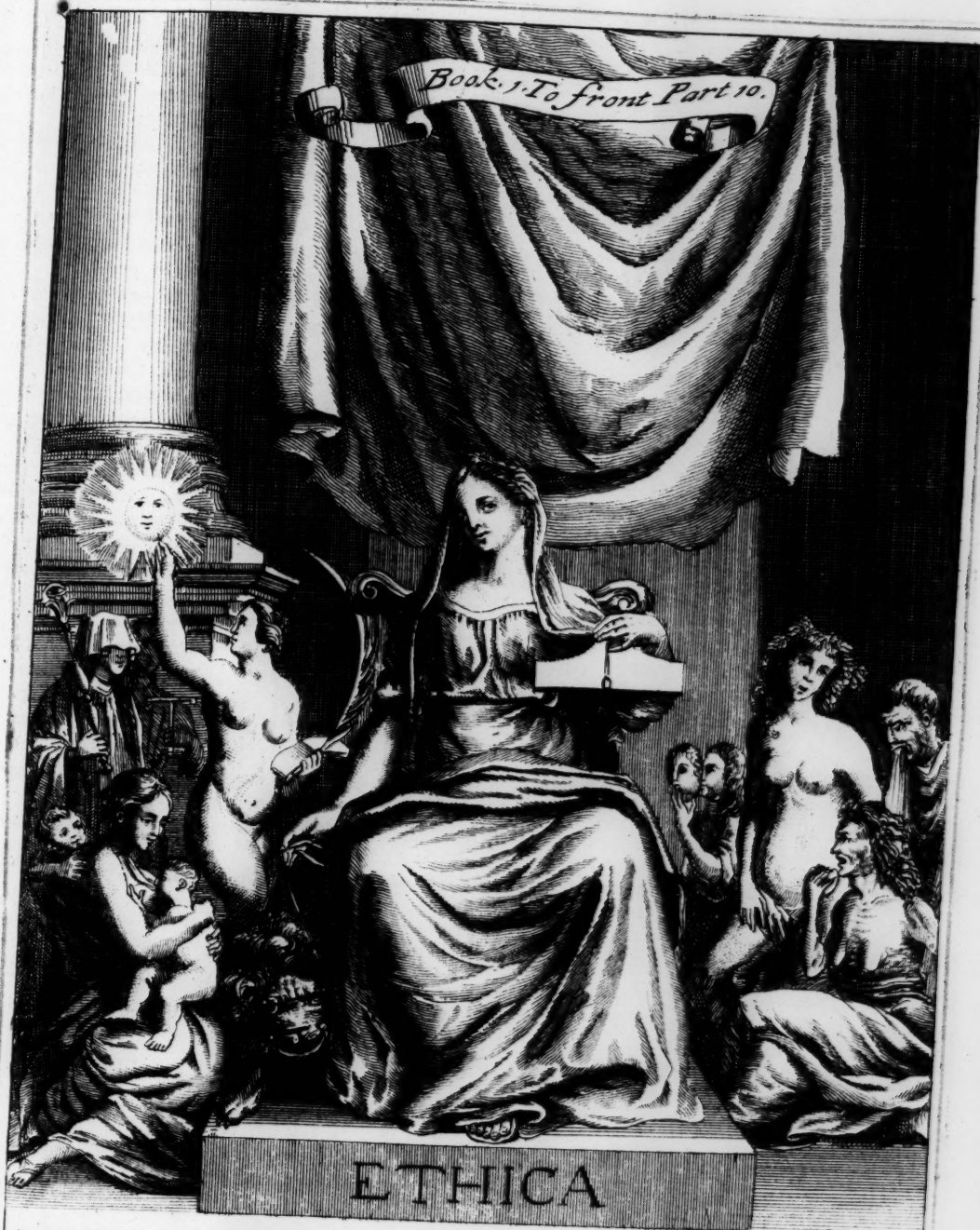
TH O' all *Philosophy* was Invented for the Good of *Man*, and there is no part of it, which is not conducive to his *Natural Felicity*; yet doth **ETHICKS** deservedly take the first place amongst them all, as excelling them, both in Usefulness and the Worthiness of its End. For whatsoever other *Sciences* prescribe, is only an Exercise and Accomplishment of *Human Wit*; whereas the *Rules of Ethicks* are the Remedies of the Soul. *Logick* may pride her self, for that her *Rules* direct and guide the Operations of the *Mind*, and by putting a difference between *Truth* and *Falshood*, illuminate the *Understanding*, and prevent it from falling into *Errour*: But *Ethicks*, taking a higher flight, enquires into the Nature of what is *Good*, persuades the pursuit of it, and having discover'd its Charms and Amiableness, allures *Mortals*, and enflames them with the *Love* of it. *Natural Philosophy* may boast her searching into the *Essence* of things, and that by penetrating all the *Secrets* of the *World*, she discerns those hidden Properties that escape the most piercing *Eye*: But *Moral Philosophy*, pursuing a more Noble Game, teaches us to subdue *Monsters*, to tame our *Passions*, and to be Victors over them. Let *Metaphysics* please her self, that mounting up to *Heaven*, she takes a view of *Intelligences* separate from *Matter*, and by a daring Undertaking endeavours to discover the *Divine Majesty, Power, and Unity*: Whilst *Ethicks*

with much more certainty displays the *Honour* that is due to *Angels*, and the *Worship* we owe to *GOD*; and by manifesting to us that *Supream Essence*, as the first and chieft of all *Beings*, doth not only put us in mind of the *Obedience* and *Observance* we owe to Him, but also forceth us to believe it most due to Him.

Who is there amongst *Men*, that doth not prefer the *Love* of *Good* before the *Love* of *Truth*, and that would not rather embrace *Vertue*, than to please himself with the barren Knowledge of it? I confess it is a Noble thing to understand the *Affections* of *Material things*, and to search out the *Nature* and *Properties* of all the sorts of *Beings* contained in the *Universe*: And yet who must not own, that it is far more glorious to put a Curb in the Mouth of *Concupiscence*; and to undervalue all the gay *Bubbles*, which almost the *World* doth admire and doat upon? What can be imagin'd more great and wonderful, than to wrestle against *Fawning Lust*, and to retort the Darts of this *Domestick Enemy* upon himself? Is it not the express *Character* of a great and sublime Soul, to despise *Honour*, and to prefer a mean and low *Estate* before the *Pleasures* of the *Court*, and the top of *Grandure*? All those are the Effects of the good Counsel *Ethicks* gives us, and all the great Qualities we so much admire in *Men*, are but the product of her *Precepts*. And therefore the *Ancients* look'd upon that *Philosophy* to be in a manner fruitless and to no purpose, which did not restrain our *Passions*; which did not put us upon the practice of *Vertue*, nor insinuate into our *Minds* the wholesom *Laws* of *Nature*.

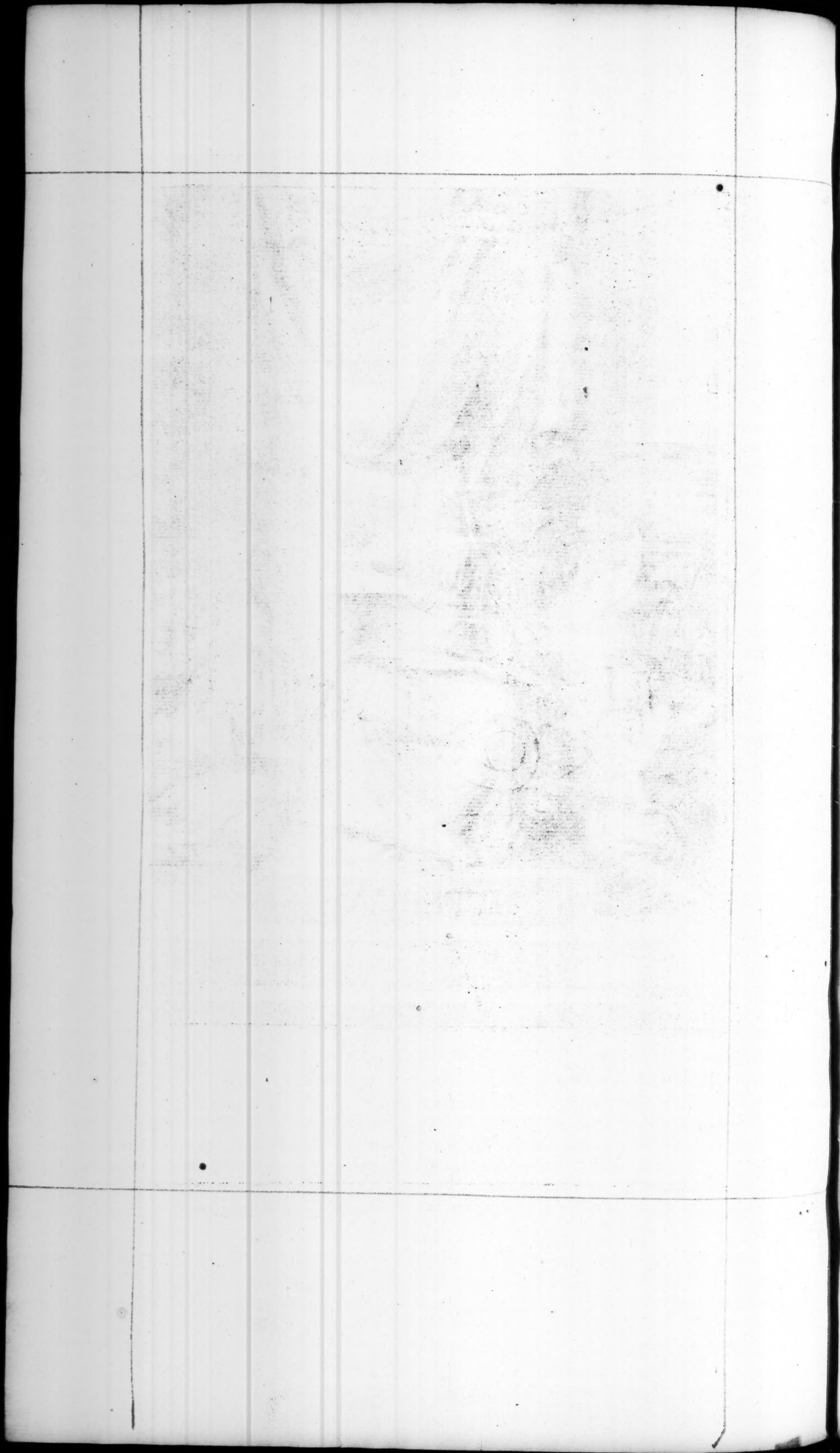
For

II.
It is a
more
excellent
thing to
pursue
Goodness
Truth.



G. Freeman. In.

J. Kip. Sculp.



III.
Ethicks
cures the
Diseases
of the Soul.

For as that Art of *Physick* is of no use, which cannot remove the *Disease* of *Mans Body*, or teach us how *Health* may be preserved or restored; so there is little or no advantage in that *Philosophy*, which doth not remove the *Maladies* of the *Mind*, and which like some *Trees* produceth nothing but *Leaves*, and pleaseth us only with the shade of *Words*. This commendation doth only belong to *Ethicks*, who like a *Mistress* of *Manners* informs *Men* what they ought to do; and is indeed the discipline and exercise of *Actions*, rather than of *Words* or *Notions*. If we take a view of the extent of her *Power*, it is she that first built *Cities*, and reduced *People* of different inclinations into *Societies*. She it is that instructs *States-men*, and teaches them the *Art* of *Governing*, shewing them how they may avoid the *Envy* of those that are governed. She it is that informs *Husbands*, how they are to behave themselves towards their *Wives*, with what care they are to mind the *Education* of their *Children*, and to govern both the one and the other, without injuring them. She it is that prescribes *Rules* to *Masters*, how to govern their *Servants*: In a word, there is no manner of *Life*, which is not directed by her advice, and which doth not borrow the *Rules* of *Governing* and *Obedience* from her.

IV.
What
things are
to be hand-
led in this
Tenth part.

In order therefore to the more distinct discovery of the end of *Moral Philosophy*, it will be worth my pains in a few *Words*, to declare what I intend to treat of in this Part, and to lay open the whole Order and disposition of this Work. First, I intend to begin with the Nature of the *Summum Bonum* or *Highest Good*, and to shew wherein it precisely consists; next I shall proceed to the *Definition* of *Virtue*, which I distribute into two Parts.

V.
The divi-
sion and
Nature of
Virtue.

One of these, named *Prudence*, is the *Directive*, she that giveth *Instruction*. The other are the chief *Doers*, employed in the making men *vertuous*.

The First whereof re-
gards our selves, viz. { *Temperance*
and
Fortitude.

The latter regards o-
thers, viz. *Justice* { *GOD*, and this is *Godli-*
ness or *Religion*.
towards *Men*, which is *Benevo-*
lence and *Beneficence*.

Neither have I unadvisedly resolved upon this *Method*, forasmuch as the *Vertues* are a help to us, in the constant prosecution of this *Highest Good*, and as so many steps, whereby we raise our *Souls* to that which is *Worthy* and *Honest*. And having done this, I proceed to the use of the *Passions*, as being the Matter for the exercise of *Vertues*, and whereon they chiefly exert their *Activity*. To these I add a few Chapters of *Human Actions*, wherein is chiefly treated concerning the *Liberty of the Will*, whether it belong to *Man*, and whether it be consistent with the *Knowledge* and *Power* of *GOD*. Upon this occasion also, I enter upon the examination of the *Goodness* and *Evil* of *Human Actions*, and when they may be said to be conformable to right *Reason*, and when to thwart and cross the same. And Last of all, I shut up this discourse with the *Duties* of *Man* in general, and of a good *Citizen* in particular; in which two

considerations, all that belongs to *Man* may be comprehended. I would also have the Reader to take notice, that in this Treatise I follow the Sentiments of *DES CARTES*: And tho' he hath writ but little concerning *Moral Philosophy*, yet I have a mind to raise this structure upon the Foundation he hath laid, and from what he hath Writ concerning the *Soul* of *Man*, and the *Passions* to discover his Sense of *Moral Matters*.

CHAP. I.

Of the Nature of Ethicks, and the principal Parts thereof.

Forasmuch as *ETHICKS* is a part of *Philosophy*, and the *Directrix* of *Human Life*, accordingly she derives her certainty from her own *Principles*; which do so much conduce to the obtaining of her end, that without their assistance, *Goodness* and *Virtue* can never be had. For as *PLATO* well observes, it is not by an impulse of *Nature* only, or by *Divine choice* and *favour*, that *Vertues* are acquired, and *Vices* banished; but it is necessary to call in *Science*, or rather the Art of *doing well*, to our assistance, that by her *Rules* and *Directions*, we may be exercised to good manners, and the inborn *Seeds* of *Virtue*, that lye buried in us, may be cherished and spring forth. And if at any time some have been known to arrive at the perfection of a *Virtuous Life*, without the precepts of *Ethicks*, yet must not we therefore deny her to be an *Art*; no more than we refuse the title of *Art* to *Physick*, tho' sometimes we may recover our *Health* without it.

I.
The Cer-
tainty of
Moral Phi-
losophy.

Some think it is but a small thing to undertake the *Explications* of the *Precepts* of *Ethicks*, because the *Rules* conducing to the right deportment of our *Lives*, seem so very notorious and familiar, and common to all *Nations*. Who knows not, say they, that *Virtue* is to be had in esteem and practised; that *Parents* are to be obeyed and honoured; and that *GOD*, whom all adore, is to be beloved above all things? It is proper indeed, to form *Rules* concerning things we are ignorant of; but as for Matters that are known to all men, these are best left to every ones own *Sense* and *consideration*. For my part, I should be apt enough to be of their mind also, if all men did agree universally in the *Principles* and *dictates* of this *Art*, and if all without exception embraced, what seems evident to some. But alas, most men now adays are so infected with the itch of *contradiction*, that they many times start, and maintain new *Opinions* only to gratifie their wrangling and disputing *Humour*. As appears more particularly in this Matter before us, for tho' the name of *Moral Philosophy* be tost in the mouths of all men, yet there are but few that concur in their *Sense* about the nature of it; and notwithstanding it be very dangerous to mistake in the forming of our *Manners*, and the due regulating of our *Lives*, yet many chuse rather, to question the truth of *Moral Dictates*, than to want an opportunity of thwarting and contradicting the *Sentiments* of others, tho' never so clear and incontestable. But may I never be tainted with this *Evil*, whose aim only is, to pursue *Truth*, not concerning my self about what others teach, or what *Opinions* they espouse:

II.
Tho' Ethicks
in it self
be very
familiar,
yet there
are but few
that agree
in explain-
ing of its
Nature.

My

III.
The Definition
of E-
thicks.

My design only being to explain what *DES CARTES* hath left in writing about these *Matters*, and to pursue his sense and meaning.

Wherefore from his *Method of discoursing a-right*, I gather this definition of *Moral Philosophy*: viz. that it is a right way or course of thinking, in order to the obtaining of *Human Felicity*. Or a Discipline directing man, in his voluntary Actions, so as to live well and happily. In the name of *Discipline*, it agrees with the other parts of *Philosophy*, but is distinguished from those *Arts*, which leave behind them some perceptible Matter, when the Action is over. For *Moral Philosophy* is not conversant about any *External Matters*, nor considers *Bodily Actions*; but is intirely employed and concern'd about the inward Operations of the *Will*, inasmuch as they are submitted to *Right Reason*, and by it directed to that which is *Good*. Wherefore to constitute its difference from other *Arts*, it is added to live well and happily; that from thence we might gather, that the *Mind of man* is perfected by *Moral Philosophy*, and directed by its precepts to act rightly, and comporting with reason.

IV.
The Object
and end of
Ethicks.

The Object of *Ethicks* is *right reason*, which is to be exercised towards all persons and things, and in all our *Actions*, and the several circumstances of them. Or if you will, it is *man* himself, inasmuch as he can and ought to be directed to an *Honesty*, that is *Moral, Good*, according to certain reason. And the end of *Ethicks* is to perfect *man*, and make him happy. For if a *man* be steadily conformable to *right reason*, in all circumstances of *Persons, Things and Human Actions*, he is arrived to the highest top of his *Moral Perfection and Blessedness*.

V.
What Man-
ners are.

The word *Ethicks*, signifies nothing but *Moral*, or that which concerns *Manners*; and accordingly *Ethicks* takes upon her to frame and direct our *Manners*; which are nothing else, but a way or course of *Living confirmed by custom*; or a certain accustomedness of *Acting*, or repeated *Human Actions*, which when they are conformable to *right reason*, are called *Good manners*; but if contrary to the same, *Vicious and Wicked*.

VI.
Ethicks
does not
so much
consider Ex-
ternal as
Internal
Actions.

And altho' many *Human Actions* are *External*, and such as cannot be performed without the help of the *Body*, as *Liberalty*, which communicates her *Benefits* to others; *Justice* which gives to every one his due, and other such like which are free, and at the command of the *Will*: Yet are not these *Actions* primarily considered by *Moral Philosophy*, but secondarily only, so far as they are the effects of *Internal Actions*, and the product of the *Will*. For the *Duty of Liberalty* doth not principally consist in the relieving of our *Friend*, but in the care and desire we have to assist him, which is the peculiar property of a generous and virtuous *Mind*. Neither can we suppose that the restoring of a *Pledge or Trust*, or the paying of a *Debt*, doth fulfil the whole requiring of *Justice*; but rather that firm purpose of the *Will*, whereby a *man* unalterably resolves to restore the *Trust* that is committed to him, and not *wrong* any by withholding their due from them. Wherefore out-ward Actions may be said to be the *Instruments* only, whereby the *Will* executes her decrees, and performs what she hath resolved upon. And tho' all particular Actions be free, as being performed

or omitted according to the pleasure of the *Will*; yet it is not the concern of *Ethicks* to consider particular Actions, but only the Actions of the *Will* in general, to which it universally prescribes, that *GOD* is to be loved, *Vertue* to be embraced, and *Vice* to be avoided, &c.

From all which it is evident, that *Moral Philosophy* is not merely *Speculative*, or consisting in the sole contemplation of *Manners*; but that it is to be reckoned amongst the *active Sciences*, its work and business being to form our *Manners*, to instruct us to *Vertue*, and prescribe the *Rules of well-doing*.

Moral Philosophy is commonly divided into three Parts, viz. into *Private, Domestick and Politick*. For *man* may be considered under various respects; First, as he is a particular man, that is, as he takes care of himself, and provides for his own Good: Secondly, as he is the Master of a Family, and performs the Duties incumbent on a Master or Parent; and Lastly, as he is concern'd in the Government of a City, or Commonwealth, and the giving Laws to others. All which diversities of Offices or Duties, are directed by so many several parts of *Moral Philosophy*. The *Private*, which some call *Monastick or Solitary*, is that part of *Ethicks*, which gives Rules how men in their singular State ought to behave themselves: The *Domestick or Oeconomical*, is that which lays down Precepts, how Families may be rightly ordered: And the *Political* teaches and instructs us in whatsoever conduceth to the good of Societies, and how both *Magistrates and Subjects*, are to behave themselves in their several Stations: For seeing that *man* stands in need of the Help and assistance of others, as well with reference to those things which are the necessities of Life, as those which are the comforts and conveniences of it; he is assisted in those things which are necessary to Life by his Family, and by the Society or Commonwealth, with that which conduceth to his safety and well being.

But whatsoever *Modern Philosophers* may talk of this distribution of *Ethicks*, it seems clear to me, that the two latter parts of *Moral Philosophy* are contained in the former, and that if a man be only instructed in good Manners, this is sufficient to qualify him, for the well and happy governing of his House or Commonwealth. For it is still a *Private man*, that manageth matters, whether in a Family or Commonwealth, and who certainly will be by so much the more fitted to discharge his Duty and Trust in either, by how much greater command he hath got over his Passions, and the more eminent he is in *Vertue*. For the *Vertue* of a *Private person*, doth not differ from that of a *publick and Political*; no more than the *Felicity* of the one, differs from that of the other. For whatsoever the *Private* part of *Ethicks* professeth, the same is with equal Right contained in the two others, viz. the Science of Life, besides which nothing is taught, or contained in the *Oeconomical and Political*. Neither can we assign any other difference betwixt them than there is, in the several Pipes of *Wind-Engines or Instruments*, in which one and the same *Wind* produceth several Sounds. In like manner all men receive from the *Private* part of *Moral Philosophy*, the Rules of living well and conformably to reason,

VII.
Moral Phi-
losophy as to
be account-
ed amongst
the practi-
cal Sciences

VIII.
Of the
three parts
of Moral
Philosophy.

IX.
The Dom-
estick and
Political
parts of E-
thicks are
reducible
to the pri-
vate.

son, notwithstanding that as the greater Pipes of an Organ yield a deeper Sound, so those who are in high and honourable places in the Commonwealth, may have a more large field wherein to exercise their Vertues, and more ample matter, of giving illustrious and signal instances of their Firm Probity.

C H A P. II.

What Good is, and how and why the same is desired.

I.
Nothing is Good but with reference to another.

Before we proceed to explain the nature of Good, and to discover that which is the desire and delight of all men; we are to take notice, that a thing considered in it self, cannot be said to be either Good or Evil, but only with reference to some other thing, to which it is conducive to attain that which it pursues, or on the contrary. Thus *Venom* is good and wholesome to a *Serpent*; but hurtful and destructive to *man*. And therefore, if we except *GOD Almighty* only, who doth good to all, and preserves the Being of every thing; there is nothing in the *World*, which in a different respect may not be accounted Good and Evil. But this being so, a difficulty seems to arise, how then we may come to know and perceive that which is Good, and how to distinguish it from that which is Evil.

II.
Good cannot be defined with the reference it hath to our Appetite or desire.

Some define the *Essence* of Good by our inborn Propensity, or Inclination; as supposing that to be Good which excites our desire, and allures us to embrace and pursue it. But these according to my Judgment, do not exactly enough lay open the nature of Good. For that Inclination whereby we are carried out to desire that which is Good, supposeth it to be something that is suitable to our Nature, so that the thing must be endued with the formal reason of Goodness, before ever it can move our Appetite. For Appetibility or desirableness, is nothing else but an Affection or Property of that which is Good, and which flows from its Essence. Now it is inconsistent with the Rules of true Definition, to make the proprieties of things to constitute the natures of them.

III.
The true Definition of Good.

Good therefore may better be defined thus, viz. that which is acceptable and suitable to every one. And that this is a true Definition, will appear by an enumeration of the several general heads of Good things; for all Good is comprehended under one of the three heads of *Honest*, *Pleasant* or *Profitable*. An *Honest Good* is that which is agreeable to right reason, and is desired for its own sake: As *Vertue*, *Piety*, to love Good, to honour ones Parents, to relieve the Poor, to curb the lusts of the Flesh. *Pleasant Good* is that which is desired for delights sake (yet without thwarting the *Honest Good* and *Right Reason*) as *Musick* delights the Ear, a curious Picture the Eye, and the conscience of Good deeds, does afford innocent pleasure to Mind or Body. *Profitable Good* is that which is Good, in order to some other thing, for the acquiring whereof it is desired, as *Money*, *Riches*, &c. But not one of all these is called Good, save only in reference to its being suitable, or agreeable to some other thing. The reason whereof is this, because the operation of the Understanding, must go before the Act of the Will; and therefore it is necessary that the Object be first

known to be agreeable to a reasonable Nature, before that the Will can be carried out towards it.

Now it will be easie to shew how, and in what manner things are carried out towards that which is Good, that is to the desire of that which is agreeable to, and convenient for them, if we consider the two Appetites in Man, whereof the one is call'd *Innate*, the other *Elicit*: The *Innate Appetite* is an inborn inclination, whereby a thing is carried towards that which is convenient for, and acceptable to it. Thus the *Peripatericks* generally hold, that the *Fire* by a natural propensity tends upwards; and that *Plants* attract a suitable Aliment out of the *Earth*. Tho' indeed this seems very difficult to conceive, that things utterly devoid of Sense and Knowledge should desire any thing, or be endued with any propensity. We cannot deny, but that in things of this nature, there are some certain Laws of Motion, appointed by the Author of Nature, which may be said to be a kind of inward propensions; as that every motion affects to pursue a right Line; but we yet must have a care, not to attribute any Appetites or Inclinations to things, when we search into their more hidden Qualities, for this would be to confound the Attributes of the most different things. Wherefore Appetite is only to be attributed to Man, it being an Act of the Will, whereby upon previous Understanding, it is carried out to that which is convenient for it.

Wherefore when I say, that *Inanimate things* have an Appetite, I would not be so understood, as if I did attribute any Knowledge to them, by which they desire things grateful, and avoid the contrary (for Knowledge is no where but in the Mind) but only that by an infallible necessity they follow the guidance of the Divine Reason, and indispenably obey his Will; in like manner, as an Arrow by a skilful Archer is guided to the mark, with out having any Knowledge or Perception thereof: *Inanimate things* therefore pursue that which is Good by a natural impulse, and reach it by means of Local motion, which the great Creator of the Universe hath furnisht them with. Man alone desires Good from a preceding Knowledge, because he only is posselt of a Soul, whose peculiar nature it is to Perceive, Will and Imagine.

But it may be enquired, seeing that Man doth not pursue that which is Good, without a foregoing knowledge of it, how it comes to pass, that he sometimes goes in quest of the contrary, that is, Evil? To which I answer, that Evil is never desired by Man; but whatsoever his desire is carried out after, the same is always proposed to him, under the likeness and appearance of Good. For tho' it may be, that which he hankers after, be contrary to Reason, and the Law of GOD; yet is the same always represented to him as some Pleasurable or Profitable Good, and is consequently allured to it, under the notion of its being suitable to him.

It will be sufficient for the explication of the Nature of Good, only to discover the cause, why all Men promiscuously desire that which is Good, and are byast towards it, by an inborn propensity. To do this will be very obvious, if we remember, that GOD is the supreme Good, comprehending all

U u u u

IV.
There are two sorts of Appetites.

V.
In what sense Inanimate things may be said to desire things.

VI.
How it comes to pass that Man sometimes desires Evil.

VII.
Why all Men, none excepted, desire Good.

the *Perfections* that can be conceived by the *Mind* of *Man*. Wherefore when any other *Good* is represented to us, we desire it upon no other account, but as we apprehend it to partake of the *Divine Goodness*, because by its *Essence* and *Existence* it bears some kind of Resemblance with him. And hence it is that no *Rest* can be found, either in the Possession of *Good things*, or in the *Contemplation* of *Truth*; because nothing created can equal the *Idea* we have of *Good* and *Truth*: tho' in the mean time we snatch at some imperfect *Images* and *Glances* of it, whereby our *Love* is inflamed to attain the *Supream Good*. This *Affection* also is sometimes kindled in us from the Diversity of *Objects*, as being apt to imagin that we make some approaches to the infinity of that *Highest Good*, by enquiring into the Nature of new *Objects*, and by extending the Bounds of our *Knowledge* and *Enjoyments*. Accordingly it happens sometimes that *Covetous Misers*, quitting their niggardly *Companions*, frequent the company of *Liberal Persons*; and that such as are *Sad*, keep company with those that are *Merry* and *Jovial*; and those that are *Angry* and *Froward*, with persons of *Meek* and *Quiet Spirits*; as being sensible of an insufficiency in themselves, and that they stand in need of the help of others towards the obtaining of their proper *Good*.

Now in all these there is somewhat of a tendency towards that *Highest Good*: for *Ambition* doth not proceed from an Inborn desire of *Honour*; nor doth the concupiscence of *Love* proceed from *Nature*, but from a *Pravity* of *Manners*, whilst they are panting after that Immense *Good*, and affect the Possession of that which is infinite. For the desire of that which is *Good*, is, as it were, the *Great Artificer* that endeavours to make *Created Beings* conformable to their first *Principle* and like unto him.

CHAP. III.

What the Highest Good is.

THERE is nothing sticks so close to the mind of *Man* as the desire of *Blessedness*, and tho' sometimes we can hardly obtain or reach it, yet we are still in pursuit of it. For all the other motions of our *Mind* vanish away by degrees, and in process of time are lessened and weakened. For we are not always taken with the splendor of *Honours*, or inflamed with the love of *Riches*; and *Pleasure* or *Voluptuousness* at last loseth all its charms, whereby it formerly captivated us, so that we loath the *Objects* we before panted after. But the desire of *Happiness* admits of no vicissitude, but as long as we breathe, or our *Hearts* do beat, excites us to the pursuit of it.

This is that in which all *People* do agree, that they desire to be *Happy*; and how greatly soever they may differ in their *Temper*s and *Inclinations*, yet they all unite in this *Passion*, that they all affect to be happy. And accordingly the *Ancients* called the *Highest Good* the last of all desirable things; forasmuch as the said *Good* is every way perfect and absolute, which being once attained, there remains nothing further to be desired. The *SUPREAM GOOD* therefore is that Mark which all our *Words* and *Deeds* tend to; and

as *Seafaring-men*, direct their *Eyes* to the *Pole Star*, so likewise is our *Soul* to be directed to some end, to which all our consults and deliberations of living well, and acting aright must tend.

Tho' almost all *Philosophers* have written concerning the *Highest Good*, and have left great *Volumes* on that subject to *Posterity*, yet were they never more mistaken in any thing, than they have been in that point, inasmuch that I dare affirm, that excepting only a few, they were never more unhappy in any of their undertakings than in this research after the true *Nature* of *Human Felicity*. I conceive that their mistake herein was caused by reason of their not duely considering what properly belongs to *Man*, or for want of accurately distinguishing between the functions of the *Mind*, and the motions of the *Body*; by which means, slighting the *Inhabitant*, they only had regard to his *Home* or *Lodging*.

The *Highest Good* therefore of this *Life*, is that which makes *Man*, here on *Earth*, most perfect and happy. And therefore for its sake only all other things are desired, whereas the *Supream Good* is desired for its own sake. We seem to express, at least, a kind of confused knowledge of this *Good*, when we prefer one thing before another: for when-ever we choose one thing rather than another, we always suppose the one to be *Better*: now that only is so which comes nearest to the *Best*. So that it appears we have an indelible notion of the *Best*, that is, *Supream Good* impressed on our *Minds*.

Some have defined the end of all our *Actions* to be *Pleasure*, the desire whereof is born with us, as well as the averation of *Pain*; of which number was *ARISTIPPUS* the *Philosopher*, and the *CYRENAICKS*. Others determined *Blessedness* to consist in the enjoyment of a concourse of all *Good Things*; and that no *Man* was happy, that did not possess the affluence of them all. And accordingly, for to constitute their *Happy Man*, they require that he have *Friends* to advise and assist him; that he have *Riebes* for necessities and convenience; *Power*, whereby he may command others, and make them serviceable to him; *Nobility*, to make him conspicuous and eminent; yea, and *Beauty* too, with a *fruitful Wife*, and well-mannered and witty *Children*. But, as I said before, I suppose that these *Philosophers*, who placed *Happiness* in these things, never well considered the *Nature* of *Man*, nor what belongs to his *Mind*, and what to his *Body*. For had they looked upon the *Mind*, as they ought, to have been the chief and principal part in *Man*, they would never have placed his *Felicity* and satisfaction in things that gratifie his outward Part, seeing that true satisfaction appertains only to his *Rational and inward Part*. But forasmuch as the dispute amongst *Philosophers* is not so much about the *Nature* of *Felicity*, as the *Causes* of it, that is, the means which lead to it; it shall be our care chiefly to discover, whence *Happiness* doth arise, and what that *Supream Good* is, by the enjoyment whereof we are made *Happy*.

CHAP.

VIII.
In every
Desire
there is
some ap-
pearance of
the Su-
pream
Good.

I.
All Men
aspire af-
ter Happi-
ness.

II.
What the
Highest
Good is.

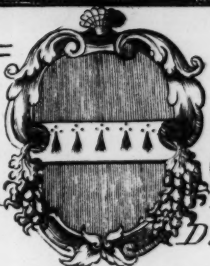
III.
Why there
be so few
that know
it.

IV.
The Su-
pream
Good dis-
tinct.

V.
The Differ-
ing Opini-
ons of the
Ancients
concerning
the Nature
of the High-
est Good.



To the Worship- full Captaine
 William Wallis of S^t Martins in
 the Fields in the County of Middlesex
 This Plate is humbly Dedicated by Richard Blome.





The following is a list of the names of the persons who have been admitted to the office of the Secretary of the Board of Education, since the last meeting of the Board, on the 1st of January, 1870.

1. Mr. J. H. [illegible]
2. Mr. [illegible]
3. Mr. [illegible]
4. Mr. [illegible]
5. Mr. [illegible]
6. Mr. [illegible]
7. Mr. [illegible]
8. Mr. [illegible]
9. Mr. [illegible]
10. Mr. [illegible]
11. Mr. [illegible]
12. Mr. [illegible]
13. Mr. [illegible]
14. Mr. [illegible]
15. Mr. [illegible]
16. Mr. [illegible]
17. Mr. [illegible]
18. Mr. [illegible]
19. Mr. [illegible]
20. Mr. [illegible]
21. Mr. [illegible]
22. Mr. [illegible]
23. Mr. [illegible]
24. Mr. [illegible]
25. Mr. [illegible]
26. Mr. [illegible]
27. Mr. [illegible]
28. Mr. [illegible]
29. Mr. [illegible]
30. Mr. [illegible]
31. Mr. [illegible]
32. Mr. [illegible]
33. Mr. [illegible]
34. Mr. [illegible]
35. Mr. [illegible]
36. Mr. [illegible]
37. Mr. [illegible]
38. Mr. [illegible]
39. Mr. [illegible]
40. Mr. [illegible]
41. Mr. [illegible]
42. Mr. [illegible]
43. Mr. [illegible]
44. Mr. [illegible]
45. Mr. [illegible]
46. Mr. [illegible]
47. Mr. [illegible]
48. Mr. [illegible]
49. Mr. [illegible]
50. Mr. [illegible]
51. Mr. [illegible]
52. Mr. [illegible]
53. Mr. [illegible]
54. Mr. [illegible]
55. Mr. [illegible]
56. Mr. [illegible]
57. Mr. [illegible]
58. Mr. [illegible]
59. Mr. [illegible]
60. Mr. [illegible]
61. Mr. [illegible]
62. Mr. [illegible]
63. Mr. [illegible]
64. Mr. [illegible]
65. Mr. [illegible]
66. Mr. [illegible]
67. Mr. [illegible]
68. Mr. [illegible]
69. Mr. [illegible]
70. Mr. [illegible]
71. Mr. [illegible]
72. Mr. [illegible]
73. Mr. [illegible]
74. Mr. [illegible]
75. Mr. [illegible]
76. Mr. [illegible]
77. Mr. [illegible]
78. Mr. [illegible]
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81. Mr. [illegible]
82. Mr. [illegible]
83. Mr. [illegible]
84. Mr. [illegible]
85. Mr. [illegible]
86. Mr. [illegible]
87. Mr. [illegible]
88. Mr. [illegible]
89. Mr. [illegible]
90. Mr. [illegible]
91. Mr. [illegible]
92. Mr. [illegible]
93. Mr. [illegible]
94. Mr. [illegible]
95. Mr. [illegible]
96. Mr. [illegible]
97. Mr. [illegible]
98. Mr. [illegible]
99. Mr. [illegible]
100. Mr. [illegible]

CHAP. IV.

That the Good Things of the Body conduce nothing to Mans Happiness.

I.
Aristotle
ranks
Health a-
mongst the
most con-
siderable
Good things
that con-
cur to Mans
Happiness.

THE Good things of the Body are commonly reduced to these three, viz. *Health, Beauty, Pleasure*; in the enjoyment whereof we are commonly esteemed happy. For if we consult ARISTOTLE, he will tell us, that *Health* is as great a Good to us, as a calm Sea is to the Birds called *Halcyons*; who, when the Face of the Sea is smooth, and not wrinkled with Winds, with great ease and delight dispatch their affairs, sit brooding upon their Eggs, hatch their Young, cherish and feed them: and that much the same pleasure and ease attends those that have a firm and healthful Constitution of Body, whereby they with cheerfulness exert all the functions of Life, and with a ready activity discharge all the Offices incumbent upon them. For when the Body is sick and weak, who knows not that the *Briskness* and activity of Man languisheth, and that the very perceptions of his *Senses* prove burthenome and irksome unto him? His Ears loath the sweetest Musick, his Sight is tired with the most Beautiful and charming Objects, the Conferences of his Friends prove tedious, and by an utter dislike of all things, he sometimes becomes intolerable, even to himself.

II.
If Health
were the
peculiar
Good of
Man, Beasts
would ex-
cel him.

But, notwithstanding all this, far be it from us to constitute the Good of Man in so mean a gift of Nature, and to make his *Felicity* to depend on his Body. For if we place the chiefest Good in a due state of the Body, shall we not make Beasts more happy than Man, who generally enjoy a more firm and vigorous health, and more perfect Senses? Whatsoever conduceth to the Happiness of Man, must be peculiar to him, and not common to him with the Brutes. Besides, the things that constitute the Highest Good, must be stable and unmoveable; but what is more weak and tottering than Health, which is overturn'd with the least fit of Sickness, and which as years encrease upon us, decreaseth continually? That which is not in our Power, but depends on another for its subsistence, doth not deserve the name of Good. Do't we see frequently that the most Learned and most accomplished Men are the most weak and sickly? And that the things which promote and assist the mind, are hurtful to the Body? Are not Studies, which inform and enlighten the Mind, and inflame the Will, prejudicial to the good Temperament and State of our Bodies which they alter and weaken?

III.
Beauty is
no part of
Mans Hap-
piness.

And the same judgment must be made of Beauty, because of its Frailty, and short continuance. For what season of the Year can be named, that doth not conspire to the defacing of it? The Winters Cold by driving the Heat inwards, much abates the florid colour of the Face, whilst the Summers Heat tans the Skin, wherein Beauty hath its peculiar residence, and sits exalted as on her Throne. But suppose we this fading Flower to be perpetual, and exempt from the Power of the distemperature of Seasons or Weather, yet after all, we shall never be able to make it a part of the Highest Good, seeing it brings nothing but trouble along with it, and disturbs the peace of those that are most possess'd of it with continual sollicitude.

How vexatiously sollicitous are Young Men and Maids to appear Beautiful to the Eyes of Spectators? What pains and inconveniencies do they not undergo, to preserve this fading Flower? How many hours do they spend in Curling and Combing their Hair, and other Trimmings, and neglect the improvement and good state of their Minds, to adorn and deck their Bodies? Nothing can be esteemed Good, but what is conducive to Virtue; but who is so blinded with the Charms of Beauty, to assert that it is any way helpful or conducive to Virtue and Honesty? When on the contrary it is apparent that it is the greatest allurements to Sin, and furnisheth the strongest incentives to Lust and Concupiscence? A Woman that sets many Hearts on fire, is in no small danger of being fired her self: And it is but seldom that we find exact Chastity and great Beauty to go hand in hand together; and there is but too just reason to suspect, that she who is too industrious to please others, is not free from impure desires her self. Wherefore conclude we, that Beauty cannot be ranked amongst the Good things that constitute Human Felicity, as well because it is so brittle and fading, as because it gives occasion to promote Vice and advance Folly.

But there are none that more abuse the name of the Highest Good, than those who place it in Pleasure, and take its height from sensual delectation. not that I suppose this to have been the opinion of EPICURUS, as most do, since I am persuaded that his Precepts were Vertuous and Good, and that he made use of the word Pleasure, not to advance Voluptuousness, but to promote Virtue, as I have elsewhere shewed at large. Wherefore I do here contend with them only, who owning nothing in Man besides his Body, suppose that his happiness consists in abounding with Pleasure, and that he is then Blessed when every part of him hath its share of joy and delectation.

But these may be easily convinc'd of their error, by putting them in Mind, that by setting this Estimate upon Mans Happiness, they level him with the Beasts, and assign to him no greater Good than Swine themselves do enjoy. Nothing can enter the Constitution of the Supreme Good, but what is Eternal, and which affects the Soul in such a manner, as to be hurtful or prejudicial to no Body, and never causing wearisomness or loathing. Whereas Pleasure is inconstant, and soon languisheth, and is extinguish'd when it delights most. Whatsoever is the true Good of Man, doth not thwart any other Good, but is advantageous to Virtue, and to his Body and Soul; whereas there is no greater Enemy to Prudence than Pleasure; nothing that more overcasts the Mind, and fills it with disquiet and ignorance; being always Rash and Precipitant, impatient of Advice or Counsel, and not so much the effect of Choice, as of a sudden attack and onset. What agreement can there be betwixt Human Felicity and such a Good as this? The thing must be Immortal and Eternal, that can make an Immortal Soul Happy.

Besides, how can the Highest Good of Man consist in that which is common to Good and Bad, to the Criminal as well as the Innocent; that which enticeth Men from Virtue, and clouds their Judgment; the affluence whereof clogs and breeds a loathing, and commonly ends in Sadness and Repentance?

IV.
Bodily
Pleasure
cannot
make Man
happy.

V.
They that
constitute
the Felicity
of Man in
Bodily
Pleasure,
do level
him with
the Beasts.

VI.
Pleasure is
common to
Good and
Bad Men.

penance? Now that all these things may be truly affirmed of *Pleasure*, is evident to every one that considers the Nature of it.

CHAP. V.

External Good Things are not the Good of Man.

I.
The Good things of Fortune are not in our Power, and therefore do not belong to us.

Forasmuch as *Suitableness* constitutes the Nature of *Good*, and that we always desire that which is most agreeable to our Nature, we do abuse our innate *Faculties*, when-ever we desire things that are not suitable to us, or which are not in our own *Power*: which they evidently seem to be guilty of, who rank outward *Goods* amongst those *Good things* that are conducive to the *Happiness* of *Man*. For such as these pursue *Happiness* in matters that are foreign to them, and the Acquisition whereof is not in their own *Power*. Whereas what can be imagined more foolish than to prosecute a *Precarious Felicity*, and to borrow the means and helps of a *Happy State* from foreign things? Who ever acquired *Riches*, *Renown* or *Nobility* when he pleased? they being *Largesses* of *Fortune*, which she gives, and takes away by chance, and at random.

II.
Riches are frequently a Man's greatest Enemy, and most prejudicial to his Peace and Quiet.

You'll say that *Riches* are necessary to a *Happy Life*, forasmuch as they furnish us with many comforts and conveniences. But for all this, I shall never admit any thing to enter the constitution of the *Highest Good*, except it be first demonstrated to me to be *Good* in it self, or that it be in the possession of such a one, who can *vertuously* make use of it. But where is he that *understands* the true value and worth of things, and estimates them accordingly? Where is the *Rich Man* that is not puffed up with his *Riches*, that doth not despise his *Inferiors*, and doth not scorn their company? *Riches* indeed may conduce to *Pomp* and *Splendor*, but not to that state which we require in a *Wise Man*, viz. a constant calm and sedateness of *Mind*. For with what racking sollicitude are they tormented in the acquiring of them? What *care*, what *pains* do they take to preserve them when got? So that they may truly be said not to possess their *Riches*, but to be possessed by them. Besides, the possession and enjoyment of *Good* must needs fill and satisfy the *Soul*: But where is the *Rich Man* that is content with his Condition, seeing that they are never satiated with *Gold*; and that all their acquisitions serve but to enlarge their *Desires*, and render them insatiable? Lastly, we find nothing more frequent and obvious than that *Riches* do debauch *men*, and corrupt their *manners*, and tempt the best *Natures*, sometimes, to the worst of *Vices*. It was *Riches*, far more powerful than *Swords* or *Darts*, that broke and vanquished the *Roman Vertues*, and made *Slaves* of them, who had mastered the whole *World*. The *Romans* were every where *Conquerors* whilst they were poor, neither could any thing stand before them; but were conquered and trod upon as soon as they began to wallow in *Riches*.

III.
Riches cannot make Men happy.

Moreover, that which is the *Highest Good* must needs accomplish and Bless *Man* in the highest degree, it must needs be constant and permanent, be desirable for it self, belong to *Good Men* alone, and exclude all *Evil*; but nothing of all these can

be found in *Riches*. For *Riches* are not desired for themselves, but for the ornament and convenience of *Life*; they are more frequently possessed by *Bad*, than *Good Men*, as daily experience sheweth; they are the *Cherishers* and *Fomenters* of *Vice*; they do not bar or keep off *Evil*, they do not fill the desire, and they often make a man infamous and corrupt him, instead of making him better.

Neither can *Honour*, with any greater Right, lay claim to the title of *Good*, as wanting stability and permanence, and any other subsistence but what they have in the opinion of *men*. For they do not long follow the same person, but shift continually, and imitate the inconstancy of the *People*, whose breath they depend upon. Do not *Histories* furnish us with Examples of those who from wielding a *Scepter*, have been reduced to hold the *Plough*; and who from a state wherein they were raised, not only above the Heads of others, but above the *Laws* themselves, were forced within Bounds, and had their extravagant Power retrenched? Did we never hear of *SEJANUS*, that most famous *Roman Consul*, who was the *Emperors Deputy* and *Lieutenant General*, and whom *TIBERIUS* called his Friend, how upon a Letter from that *Emperor* to the *Senate* he was cast into *Prison*, and ignominiously treated, being abhorred and flouted at by those, who worshipped him but a while before? And shall we not conclude from these, and a thousand other instances that *Fame* and *Honour* are brittle like *Glass*, and inconstant as the *Wind*, which whilst it flatters, doth ensnare us, and when it shines strongest, is nearest its setting. Lastly, why should *Honour* be desired, since it doth not depend on him who is praised, but is wholly in the *Power* of those who give it? Neither are *Men* *Honoured* because they are *worthy*, but because others think them so.

Others again cry up *Nobility*, and think it very much injured by those who reckon it amongst indifferent things, which do not concur either to *Happiness* or *Misery*. For they suppose it to be an innate *Worthiness*, founded upon the *Vertue* and *Achievements* of their *Forefathers*. But how can this make them better, since the *Nobility* they value so much is none of their own, but wholly derived and borrowed from others? Every one must have his own *Vertues*, since it is impossible for any *Man* to borrow them from another. What, am I to be accounted *Noble*, because my *Parents* or *Ancestors* were Famous and Renowned for their *Vertue*, and because they deserved well of their *Prince* and *Country*? We *Pride* our selves with that which is anothers, whilst we boast of our *Pedigree*, and arrogate the *Praises* of our *Ancestors*, as if due to us? For what else is this but to Rob the *Dead*, and to expect *Glory*, for what we never labour'd for? But besides this, how often doth *Nobility* take its rise from *Crimes* and *Wickedness*, and how frequently hath an honourable Title been the reward of *Murder* or *Treachery*? What more common than to purchase *Nobility* with *Money* or *Pimping*, and for a man to become illustrious for his *Vices*? The Posterity of such as these cannot be said to be *Noble* but *Notorious*, and the Rise of the *Fathers Gentility*, becomes the reproach of his *Children*. But we'll suppose your *Ancestors* to have been all of them great and Gal-

IV.
Honour is a Fickle Good, and depending on another.

V.
Nobility being an external advantage only, cannot make Men happy.

lant Men, and to have been beholden to their Vertue only, for their Nobility; yet can they not transmit this *worthiness* of theirs to you, nor indeed any thing besides their Riches, which without any regard to the Vertue of our Forefathers, we do often abuse to the Ruin both of Soul and Body. How often do we meet with Gentlemen by name, who, as to their Manners and Accomplishments, are very mean and inconsiderable? He is Noble, who hath a great Soul, disposed to Vertue and Goodness, who knows things that are Right and Honest, and doth heartily love and pursue them.

CHAP. VI.

What is the Highest Good of Man in this Life, and his Ultimate End.

I.
How the Highest Good, Happiness and Beatitude may be distinguished.

THO' from what hath been already said, it doth in great measure appear, what that is which we call the *Supream Good*, yet will it be of use in the beginning of this Chapter, to enquire what *Felicity*, and what *Bliss* is, and how they differ from the *Chiefest Good*. We commonly call them *happy*, who abound with the *Goods of Fortune*, and who without their own *Wit* and *Industry* jump into *Riches* and *Honours*. And therefore such are commonly said to be more *Fortunate* than *Wise*; forasmuch as the things they possess are only *external*, and do not properly belong to them. But *Beatitude* consists in that *Joy of Mind*, and *Tranquillity of Soul* which ariseth from the Possession of the *Chiefest Good*; and the *Highest Good* is that *Object*, the enjoyment whereof makes us *Blissful*, and than which nothing higher or better can be desired by us. So that the *Highest Good* of this Life is that which makes a Man *Blessed and Perfect here on Earth*, according to the Possibility of this State. And therefore all other things are only to be desired for the sake of it, and it only desirable for its own sake.

II.
The Chiefest Good of Man in General.

It will be useful also for our better understanding of the *Nature of the Chiefest Good*, to consider Man in a double state, and that is either as a *Private Man*, and as he is a person that takes care of himself, and refers all things to his own Good and Interest: or as *Man-kind*, or the *Nature of Man* in general, which comprehends all Men, and does, as it were, constitute a *Body Politick*. The *Chiefest Good* of a Man considered in this latter sense, seems to be no other than a *Concurrence of all Perfections* whereof he is capable. For so Man cannot be looked upon as most perfect, without he be furnished, not only with the *Goods of Soul and Body*, but also with those of *Fortune*.

III.
The Chiefest Good of a Private Man.

But forasmuch as we do not enquire here what it is that makes *Mankind*, or all Men collectively taken, *Happy*, but what makes every singular Man so; we say that the *Chiefest Good* of a *Private Man*, is the right use of his Reason, and which chiefly consists herein, that he have a firm and constant purpose of always doing that, which he judgeth to be best. And this is therefore the *Chiefest Good*, because no Good must be esteemed by us more than it, and all other things undervalued in comparison of it. And then because we enquire here after a Good which is in our Power, and can be obtained by us; and that the Good things of

the *Body* and *Fortune* are without us, and come to us, and go from us without any contrivance or endeavour of ours; nor can we be said to possess those things which are only borrowed by us, and which we may lose the next moment; therefore it is of absolute necessity that we place our *highest Good* in our *Mind*, and that it depend on our *Free Will* only.

All that belongs to our Soul is compriz'd in 2 Faculties, viz. the Power of Understanding, that is, of knowing Truth and Good, and discerning them from Evil and Falshood: and the Power of Willing, or assenting to those things which we know to be True and Good. And in the right or due use of these 2 Chief Faculties, we say that the *Supream Good* of Man doth consist. Which is then chiefly done, when we diligently inspect whatsoever is propounded to us, and when we exert the utmost of the vigor of our Mind to the discerning of that which is best; which is the first Function or Office of our *Intellective Faculty*. And in the next place, that our Choice exactly follow our Perception, so as to undertake nothing which is not clear and manifest to us. For our Knowledge is the Rule of our Actions, and, as it were, the Guide of them, which we are to follow; and as long as we do so, we may be said to be out of the reach of Error: For tho' we may happen to be deceived, and tho' that which we have accounted Good may be only so in appearance, or may be indeed Evil, yet notwithstanding we are assured that we have performed what was our Duty, and have omitted nothing, whereby we might discover the true Nature of it.

Which satisfaction of Mind we shall attain to, by giving heed to, and observing these 3 things which are the Foundations of all Ethicks, or Moral Philosophy. First, That we, according to our utmost endeavours, strive to attain the Knowledge of what we ought to embrace, and what to avoid in all the Circumstances and occurrences of our Lives. For seeing that many and various things happen to us, during the whole course of our Life, which according to the different Circumstances of Time, are called by different names, we are constantly to fix our Eye upon the Dictate of Reason, forasmuch as it often happens, that those things which were once Good, are accounted Evil; and that which was Honourable, is now looked upon as Ignominious and Despicable. Above all, we must take heed of espousing the opinions of the Vulgar, not minding what Men commonly do, but what ought to be done.

The Second thing is, That we stand firm and constant to what we have once resolved upon and purposed; that is, that we retain an unmoveable Mind and Will, of doing those things which Reason commands, not suffering our Passions and corrupt Inclinations to lead us aside.

The Third, That we lay this down as an unmoveable Ground and Principle, that nothing besides our own Thoughts, is in our Power; and that therefore seeing the Goods we want, are without us, they are not to be wished for or desired by us.

The Greatest Good therefore that we can attain to in this Life, consists in the possession of all those Perfections, the obtaining whereof depends on our own Free Will or Choice; and seeing that there

IV.
It consists in the due use of his two Chief Faculties.

V.
In order to the attaining of Beatitude, three things are to be done. The First.

VI.
The Second.

VII.
The Third.

VIII.
Whatsoever doth not proceed from our Free Will or Choice, deserves no Praise.

X x x

there is nothing, besides the Exercise of *Vertue*, that is of this Nature, we are to conclude, that our proper *Good* and *Happiness* doth therein alone consist. For indeed, whatsoever doth not proceed from this Principle, neither merits *Praise* nor *Blame*; for *Praise* is the *Reward* of *Good Actions*, and can never be deserved, if they be the effect of *Necessity*, and are not the *Fruits* of our *Free Choice*. 'Tis without *Reason* therefore that we delight our selves in *Riches*, *Honours* and such like, seeing that they are things without us, and therefore do not belong to our *Happiness*. We may be allow'd indeed to have some *Value* for them, but no *Praise* is due to us for them, any further than they have been acquir'd justly and honestly, that is, in the due use of our *Reason*.

IX.
Wherin
the Bliss or
Beatitude
of a Na-
tural man
doth con-
sist.

Whence we may easily gather, That the *Natural Happiness* of *Man*, is nothing else, but that *Tranquillity* or *Joy* of *Mind*, which springs from his Possession or Enjoyment of the *Highest Good*: Which being nothing else but the *Right use* of our *Free-will*, we must conclude, that from the Possession thereof our *Chiefest Pleasure* must proceed. This will be evident as the *Sun* at *Noon-day*, if we consider, that all *Pleasure* and *Delight* is the *Inmate* of our *Soul*; and tho' there be some *Delights* which cannot be communicated to it, but by means of the *Body*, yet we may assert, that they are intimately present to the *Mind*: For it is the *Soul* which perceives all *Outward Objects*, tho' they be convey'd to her by the Ministry of the *Senses*; and it is the *Soul* alone that is affected with, and capable of *Pleasure*, whilst she perceives her self possessed of the *Highest Good*, whereof she is capable in this *Mortal Life*.

X.
It is im-
possible, but
he must be
sensible of
the Highest
Joy, who
lives in the
due use of
of his Free-
will.

Moreover, we are to take notice, that *Good things* are not so much to be rated by us, from the *Conveniences* or *Advantages* which accrue to us from them; as from the *Relation* and respect they have to us. Now seeing that *Free-Will* is properly and peculiarly ours, and that it is the *Best* thing we are *Owners* of, it follows, that nothing less than the *Highest Joy*, can be the result of the *Right use* thereof. For what can be more excellent in *Man*, than that whereby he is rais'd above all other *Animals*; than that whereby he resembles the *Great and Glorious God*, seems to stand, as it were, on even ground with him, and to be exempt from his *Command*? Forasmuch therefore as it is manifest that our *Free-will* is the greatest of all good things, and that the possession thereof is ascertain'd to us, there can be no question, but that the greatest *Peace* of *Mind*, and the most solid of all *Pleasures*, must naturally spring from the due use of it.

XI.
The Anci-
ent Philo-
sophers were
of the
same Opin-
ion.

And by giving this Notion of the *Highest Good* of *Man*, we concur with the *Opinions* of the *Ancients*, and embrace the *Sentiments* of *EPICURUS*, as well as of *ZENO*, and the rest of the *Stoicks*. For tho' *EPICURUS* placed the *Chiefest Good* in *Pleasure*, and *ZENO* in *Vertue*; yet they may easily be reconciled by saying, that *Vertue* is to be accounted the one only *Good* of *Man*, forasmuch as it alone depends on his *Free-will*: And seeing that full *Satisfaction* of *Mind* proceeds from the possession of the greatest *Good*, that therefore *Pleasure* also must be a concurrent Means to make us *Happy*.

The *Highest Good* of *Man* therefore consists chiefly in 2 things, viz. in the *Knowledge* of the *Best Good*, and in the constant prosecution of it. If any one enquire what that *Best Good* is in the knowledge and pursuance whereof we must spend all our *Endeavours*. I Answer in a word, that the *Good* of the *Universe* is, that a *Man* in particular be happy, and all others with him. For seeing that the *Greatest* of any *Good*, is to be measured by the *Relation* it hath to us, we are to take heed that whatsoever we undertake, may promote our *Happiness*, and conduce to our chief and ultimate End.

XII.
What that
best thing
is, we all
aspire
after.

And forasmuch as we are not born only for our Selves, but for our *Country*, and the *Society* and *Family* whereof we are *Members*, we are also to endeavour the well-being of others, and be no less solicitous for the *Good* of the *Publick*, than for our own. For *GOD* hath so order'd the *World*, and hath joyned *Men* in so close and strait a *Band* of *Society* and *Communion*, that tho' a *Man* should be so *Selfish*, as only to mind himself; yet *Prudence* would move him to do *Good*, and be kind to others. Besides, it is the *Mark* of a great and sublime *Soul*, to do good to others; and the *Noblest Minds* are always found most carried out to *Benevolence*, and to have a low Esteem of the *Goods* they possess: Whereas it is the *Character* of *Low* and *Little Souls*, to have a great *Value* for themselves, and little or no *Regard* or *Esteem* for others.

XIII.
We must
also do good
to others.

Wherefore *Private men*, and such as mind their own Interest, are oblig'd, as well as those who are in a more *Publick Station*, to be helpful and assistant to others; and if they act prudently, will endeavour, to the utmost of their Abilities, to be beneficent to others, doing them all the *Good* they can. For this is the end and design of *Human Policy*, or *State Government*, to settle such *Laws* whereby we may be helpful and useful to one another, or at least, not be hurtful or prejudicial to our *Neighbours*. For whosoever shall thus sincerely and heartily obey the *Common Laws* of the *Society*, shall without doubt live more happily and safely, than those who pursue their own profit, without any regard to the *Publick Good*; who tho' sometimes they may seem to prosper, yet for the most part have an unhappy End, and frequently come to their Fall and Ruin, by those selfish and unjust Means, whereby they design'd to raise themselves.

XIV.
The Interest
and con-
cerns of
the Publick
are to be
prefer'd
before any
Private
Concerns
whatsoever.

CHAP. VII.

Of the Nature of Vertue in General.

Forasmuch as *Vertue* alone can make us happy, we can do no less than treat of it in particular, to the end we may be fully informed of the Nature of that thing, the possession whereof procures our *Felicity*. For tho' all *Men* own *Vertue*, yet do they not agree in their Thoughts about the Nature of it. But not to trouble my self about enumerating the *Opinions* of others, I say, that *Vertue* consists in a *Steady Resolution* and *Vigour* of *Mind*, whereby we are carried to do things we believe to be *Good*. For *Man* only is *Praise-worthy* for those things that are in his *Power*, and which depend on his firm *Resolution* of *Well-doing*.

I.
The Defi-
nition of
Vertue in
General.

doing. And it is of absolute necessity, that he who would Live well and happily, be constant and unmoveable in his *Resolutions*; for he that is wavering, and tost this way and that way by manifold *Passions* and *Inclinations*, doth not act, but is a Slave to his *Passions*; neither follows that which is best, but what is most pleasing to his *Lusts* and *Affections*.

The most necessary therefore of the Requisites to *Vertue*, is a *steady purpose and vigour of Mind*, by which we are readily and fully carried to the prosecution of that, which after due Examination, we find to be *Best*, without suffering our selves to be stopp'd or turn'd aside by any *Passions* or *Appetites* whatsoever. For as *Vice* proceeds from *Doubt* and *Wavering*, which are the Consequents of *Ignorance*; so on the contrary *Vertue* is founded upon a firm and steady Purpose of performing whatsoever *Right Reason* doth suggest. Which *Right Reason* is nothing else, but a *true Sense and Judgment concerning Human and Divine things*, as far as they belong to, or concern us. Wherefore also this is that which is the proper and peculiar Good of *Man*, whereby, to speak with the *Stoicks*, he excels *Beasts*, and follows *GOD*.

Nor will this sound strange to us, seeing *Reason* is no other, but that *Power of Understanding* and *Judging*, derived from and communicated by *GOD*, the *Highest* and *First Reason*, which therefore we are to follow as a *Rule* in all our *Actions*, and to which we are to have a constant *Eye*, as to our *Sovereign Lady*, whose *Power* over us is most *Lawful* and *Equitable*, whose *Laws* are *Irreprehensible*, and all her *Statutes*, *Beneficial* and *Perfective* of our *Natures*. So that he that *Obeys* and follows her, cannot go astray, since by keeping her *Dictates* he obeys the *Divine Law*, written in his *Mind*, which is the *Source* and *Rule* of all *Equity*.

We have already said in the *Explication* of *Vertue*, that it is a *firm purpose of doing those things, which Reason tells us are Best*; because it is requisite that this *Will* be firm, and that the things we undertake, be thoroughly Examined by us. For those who perform the greatest *Actions*, do not merit any *Praise*, if they be not done after mature *Deliberation*, and with a steady Purpose. For *Vertue*, as *SENECA* tells us, is not an *Action*, but the *Exercise and Purpose* of it. For he who is prepar'd, dispos'd and resolv'd for the Patient enduring of the hardest *Trials*, and who is fully purpos'd to relieve and succour the *Miseries* of others, but is hindred of an *Opportunity* of exerting his *Vertuous Resolutions*, is without doubt possessor of *Vertue*, tho' he hath not been able to exert or exercise it. So that seeing it is in our *Power* to *Judge* what we ought to do, and what to omit; yet can we not of right be said to be *Vertuous*, except we have a steady Purpose of doing whatsoever *Reason* shall propound to us to be *Best*.

ARISTOTLE, *Lib. 2. Ethic. cap. 8.* thus defines *Vertue*; *Vertue is an Elective Habit, consisting in Mediocrity with respect to us, determin'd by Reason, and agreeable to the Judgment of a Prudent man.* For according to him, *Vertue* consists in the midst of two *Affections*, and derives its Excellence from the *Mediocrity* it observes between them: For perceiving that *Liberality*, for Example,

was attended by *Covetousness* and *Prodigality*; and that *Fortitude* was equally removed from *Cowardliness* and *Fool-hardiness*, he concluded *Mediocrity* to be the *Formal Cause* of *Vertue*, and to be conversant about the *Passions*, in which Excess and Defect is found. So that *Vertue*, according to him, is a kind of *Mean* betwixt 2 vicious Excesses.

But tho' this may be allow'd, as to some *Vertues*, yet it cannot be asserted of all, forasmuch as many of them admit of no *Mean* at all. For what *Extreams* can we allot to the *Affections* of *Mercy* and *Benevolence*; seeing that they, in what state soever they be consider'd, are always *Good*, and always *Vertues*, whether they be in an *Intense* or *Remiss* degree. Again, what *Mediocrity* can there be conceiv'd in *Hatred*, *Envy*, *Pride*, when these *Affections*, how temperate soever they may be, are ever vicious, and therefore can never produce any *Vertue*. For this *Mediocrity* of *Vertue* is only to be met with in those *Affections* which we call *Indifferent*, which are neither *Good* nor *Evil* of themselves, as *Anger*, *Love*, *Desire*, *Fear*, and the like. For if *Anger* be moderate, it takes the Name of *Vertue*, but becomes a *Vice*, whenever it turns to *Rage* and *Fury*, which is the Excess of it; or sinks down into *Unconcernedness*, which is the defect thereof.

Moreover, the *Love* we bear to *GOD*, and the *Grief* we have for *Sin*, are both of them *Vertues*; and yet neither of them consist in a *Mediocrity*, since they have no bounds or limits, the one of them having *GOD* for its Object, who is *Infinite*; and the other respecting his opposite, *Nothing*. Now, who can love *GOD* to Excess? or be overmuch grieved for his *Sins*, or too much incensed against himself, for having offended his *Creatour*? No Body questions, but that *Adam*, in *Paradise*, was endued with many *Vertues*, as *Justice*, *Piety*, and the like: But what was the Form of these *Vertues*? It could not be *Mediocrity*, because he was not subject to any Excess of his *Passions*. And how could there be a *Mean*, without *Extreams*? Conclude we therefore, that the *Mediocrity* of *Affections*, is not the Form of *Vertue*; and that the same may be, tho' there were no vicious Excesses at all. Besides, all own, even those that are the Followers of *ARISTOTLE*, that *Justice* is not the *Mean* betwixt two *Extremities*, nothing being oppos'd to it, save *Injustice* only; and that, because it doth not give to every one his due.

But yet I do not deny, but that many *Vertues* are thus placed betwixt two *Vices*; for it is evident that *Magnificence* is a disposition of *Mind* between *Niggardliness* and *Sumptuousness*: *Modesty*, betwixt *Ambition* and a *stupid Carelessness*, and disregard of *Honour*: *Temperance*, between an *Insensibility* of all *Pleasure* and *Intemperance*. All that I contend for is, that this *Mediocrity* is not *Essential* to the Constitution of *Vertue*, and therefore cannot be said to be the *Form* of it: For so *Mediocrity*, for Example, in *Meat* or *Drink*, doth not deserve the Name of *Vertue*, as it is a *Mean* between the Excess and Defect of *Meat* and *Drink*; but for that it is according to *Reason*, and in compliance with the *Dictates* thereof. For the *Soul* that is under the *Governance* of *Reason*, chuseth the *Mean* between 2 *Extreams*, because it finds, that

II.
A firm
Purpose
is necessary
to Vertue.

III.
The Laws
of Vertue
are truly
Good, and
unreprovable.

IV.
A firm
Purpose of
always
doing what
is Best, is
a necessary
Ingredient
of Vertue.

V.
Aristotle
makes
Vertue to
consist in
the midst
of Affections.

VI.
This Definition
doth not
hold good,
as to many
Vertues.

VII.
Charity,
or Divine
Love and
Repentance,
admit of no
Excess.

VIII.
Mediocrity
cannot be
the Form
of Vertue.

C H A P. VIII.

Of the Law of Nature and Right Reason,
with the Practical Dictates thereof.

that most suitable to it self. Neither need we to have recourse to this *Mediocrity*, since that which is most suitable and convenient for us, as we are *Rational Creatures*, must of necessity be a *Vertue*, tho' there be no Extreams between which it mediates. For he that exceeds all other *Mortals* in his *Love* to *GOD*, is so far from being blameworthy upon that account, that on the contrary he is highly therefore to be praised, because this excess is conformable to the *Precepts* of the *Natural Law* or *Reason*, which requires of *Man* the *Highest Piety*, and commands them to *Love* their *Maker*, with their whole *Mind*, and all their *Strength*.

IX.
All the
Vertues are
in conjunc-
tion.

It is a common Saying in the *Schools*, That all the *Vertues* are undivided, and link'd together, so that he that hath one, hath all the rest also; which in some Sense may be admitted, that is, when we speak of *Heroical* or *perfect Vertue*; because such *Vertue* is supposed to have all the Excellence it is capable of. Sure it is, that all the *Vertues* are helpful and assistant one to another; for it is impossible for any one to be *Prudent*, without being partaker of *Fortitude*, *Temperance* and *Justice*; neither can any *Man*, as *SENECA* saith, suffer bravely and boldly, without making use of all the *Vertues*, tho' *Patience* be the *Vertue*, that is most apparent in this case. For it is most certain, that *Fortitude* must be there also, *Patience* and *Endurance* being only *Branches* thereof: Neither is *Prudence* wanting, without which there can be no *Council* or *Advice*, who adviseth us to bear that courageously, which we cannot avoid. *Constancy* also makes one of this happy *Company*. And in a word, the whole *Chorus* of *Vertues* do meet in that one *Action* of suffering courageously; for indeed whatsoever is *Honestly* done, tho' it may be chiefly performed by one *Vertue*, yet is it not without the assistance of the rest.

X.
All the
Vertues
meet toge-
ther in
Prudence.

And to evince this beyond Contradiction, let us consider, that there can be no *Vertue* without *Prudence*, and that all *Vertues* meet and are joyned in her. For every *Moral Vertue* only executes or performs what *Prudence* prescribes, and what agrees with the *Rule* and *Line* of *Right Reason*; and therefore it cannot be otherwise but that those *Vertues*, which partake of this *General Nature*, must be linked together, according to that *Axiom*, That those things which agree in a third, must needs agree with one another. Wherefore no *Vertue* can be without *Prudence*, neither can there be any constant or ready *Prudence*, without the *Company* of all the other *Vertues*. For as *ARISTOTLE* informs us, *Lib. 6. Ethic. cap. 8.* The Judgment of our Reason about practical Principles, is subject to be perverted and deceived by the pravity of our Natures; so that it is evident that no *Man* can be *Prudent*, except he be a good *Man* also. And consequently the *Vertues* that make *Man* good, cannot be separated from *Prudence*.

Such a deep sense of the *Law* of *Nature* is impress'd upon the *Mind* of *Man*, that even the most *Wicked* and *Perverse* do profess to own and follow it: For *Men* in all their *Actions* appeal to the *Law* of *Nature*, and contend that they act according to it. A *Covetous Wretch* that with an insatiable desire scrapes and rakes together *Riches*, pretends that he acts herein according to the impulse of *Nature*, and follows her Teaching. An *Ambitious Person*, that by any means, tho' never so wicked and flagitious, makes his way to *Honour* and *Dignities*, meanly fawning upon some, that he may crush others, supposeth himself all this while acting conformable to *Nature*. He that is a *Slave* to his *Lust*, and abandons himself to *Luxury* and *Idleness*, brings in *Nature* to justify his *Lewdness*, and contends that his *Debauchery* is consonant to her *Laws*: In a word, there is nothing so unworthy and contrary to *Reason* but hath its *Abettors*, that will prove it to be conformable to the *Light* of *Nature*.

I.
Men tho'
never so
wicked, own
the Law
of Nature.

But these *Wretches* are much mistaken, who take their *Lusts* for the *Law* of *Nature*, and suppose the greatest violation of her, to comport with her own Dictates. For what *Nation* was ever so far corrupted, as not to condemn *Murthers*, *Incest*, *Theft*, *Rapin* and the like? For *Nature*, tho' it be greatly deprav'd and weakened in some *Countries*, yet for all that cannot patronize *Sin*; and as long as the least spark of *Reason* still glimmers in them, they condemn what other *Nations* forbid and punish. The *Laws* of *Nature* preserve and defend *Nature*, but are not destructive of it. Wherefore it will be worth our pains to enquire here, whether there be any certain and unalterable *Laws* of *well-living*, and doing, to which all *Men* are obliged, the violation whereof is accounted criminal amongst all *Men*: In order to the clearing whereof, we shall first consider what the *Laws* of *Nature* are, and how they may be defined.

II.
Every Na-
tion hates
Vice and
Wickedness
and punish-
eth it.

The *Laws* of *Nature* are nothing else but a certain *Light* or *Notices* which serve to guide and direct us in all particular occurrences, and which are derived from that general Reason, which *GOD* hath imprinted in the Souls of all men in their formation. We say in the first place, that the *Laws* of *Nature* are certain *Notices* which serve to guide us, &c. to distinguish the *Laws* of *Nature*, from the *Rules* of *Motion*, which we sometimes also call *Laws* of *Nature*. We say in the second place, that they are derived from that general Reason, &c. to shew that the *Laws* of *Nature*, are nothing else but the consequences and effects of the *Light* of *Nature*; adding, which *GOD* hath imprinted on the Souls of all men; to signify that the *Laws* of *Nature* are general and common, and that there is no *Man* in the World, how wicked and profligate soever he be, but hath some Sense and Knowledge of them, and that from *GOD* himself.

III.
What the
Laws of
Nature are.

And therefore *ARISTOTLE* *Lib. 3 Politic.* saith, he who will have the Law to bear sway, would have *GOD* to bear sway. As if he would intimate

IV.
These Na-
tural Laws
have GOD
for their
Author.



To the Worshipfull
of Lubeck in Saxony,
Covint Garden in
Principall Painter
King William and
This Plate is humbly



S.^t Godfrey Kneller
and of S.^t Pauls
Middlesex Knight
to their Majesties
Queen Mary.
Dedicated by Richard Blome.



The Hon. Wm. Pitt
 of Stratford-upon-Avon
 Esq. in the House of Commons
 Printed by Wm. Wilson and
 J. W. Smith in Strand
 1791

mate to us, that whatsoever Reason prescribes, ought not to be lookt upon, as the invention of Mans Wit, or the constitution of Nations; but as something Divine and Eternal, that governs the World by its Commands and Prohibitions. So that whatsoever deviates from this Eternal Law, is to be lookt upon as a Monster, and as a Sacrilege, against GOD, who is the Author of Nature, and of this Knowledge of Good and Evil in us. For what else, saith SENECA, is Nature but GOD and the Divine Reason diffused through the Universe and all the parts of it; which meets thee whither soever thou turnst thy self: All the Reason that is in material things, is the Gift of GOD who ruleth all things.

v.
That there are certain and unmovable Laws of Nature, proved from the Nature of things in general.

And that there are such *Eternals Laws* may be demonstrated from the common Nature of things. For the World which imitates the Unity of its Author and principle, is governed by one Law common to all Creatures, which as it provides for the good of the whole Universe, so of every particular Being. For whatsoever is contained in the World, is subject to the Reason of the Divine Mind, who is the Regent of the Universe. For the Beings that are destitute of Reason follow their natural instinct, and like *Arrows* shot by an expert Archer, fly directly to the Mark; and the Rational, who are guided by the dictates of their Judgment, tend to their appointed End. So that the former are necessarily, and the latter freely and of choice, subject to this common Law. Hence it is that CICERO L. 10 de legibus, saith, In the constituting of what is Right, we must take our Beginning from that Supreme Law, which took its rise before all Ages, when yet there was not any Written Law, or Civil Society constituted. And notwithstanding that almost in every different Climate we meet with different Customs and Manners; yet amongst them all, we shall find the Footsteps of this Universal Law, which binds not only the Inhabitants of one particular Country, but also those of the whole World.

vi.
From the Frame and constitution of Man.

The same may be also made out from the end and Constitution of Man, whose peculiar privilege it is to have the use of Reason, and square his Life by it. For the Dictates of Reason are so evidently imprest upon his Mind, that he readily follows what is Just and Right without any Matter, without any Written Law, without any compulsion of the Magistrate, and discerns betwixt that which is equal and unequal, by the Light of his Conscience only. It is vain and useless to instruct Men, that Murder and Adultery are Crimes, and that Theft must be avoided, seeing that the Light of Nature anticipated this their information, and that all these Laws were long before Written, on the Tables of their Hearts. And therefore the Sovereign Legislator in delivering those Laws cuts them short, Thou shalt not kill. Thou shalt not commit Adultery, without adding any reason of them, as taking for granted that he addresseth them to those who knew that already. For a Ray of the Primordial Reason, appears in Man by a twofold preeminence; for being endued with Reason, the light which illuminates other Creatures outwardly and superficially only, is his property and part of his Essence. And in the second place, the Sense of Right and Truth and Affection for it, is most intimately present in his Heart, whereby

he is directed both in his Speculation and Practice. The Minds of Men are stored with the Seeds of Virtue and Honesty, which are excited by the least admonition, like a spark of Fire, which being only assisted with a small Blast, displays it self into a great Flame.

For GOD being concerned for the Preservation of Man whom he hath made, hath of his infinite Goodness and Wisdom engraven in their Minds, when he united it to the Body, a general knowledge of what is Good, that is, an Idea of whatsoever is conducive to the preservation of that Union. And it is this Idea or Knowledge, which we call a Good understanding, Right Reason, the Light of Nature; and the particular Notices derived from this general Idea, are those we call the Laws of Nature.

And tho' some may think themselves very obsequious to the Law of Nature whilst they indulge their Flesh, and wholly abandon themselves to their Lusts, whilst they cram themselves like Swine, and are as Luxurious as Goats: Yet most certain it is that such Men as these do not follow their Human, but Animal Inclinations, and in a word, live like Beasts: For would they but attentively search into their own Bosoms, and consult the Law of Universal Nature written in their Hearts, it would appear a most monstrous and unjust thing to them, thus to disguise themselves with the Manners and Passions of Brutes, seeing that they are reasonable Creatures, and as such are obliged to direct their Lives, not by the compass of Sense, but Reason. They only Live according to Nature, who square their Actions by Reason, and who confine themselves to these three Precepts, to Live Honestly, not to Hurt another, to give every one his due. Which Precepts by the unanimous Suffrage, both of the wise and common People, are called the Fountains of all other, and a compendious, but Essential Institution of the Law of Nature.

These unalterable Laws of a good Life, may be further demonstrated from the Relation Man hath to other Rational Agents; for seeing that Man is a Sociable Creature, and affects the company of such as are like him, it is necessary there should be some Laws, whereby they might be engaged to lend their mutual assistance one to another, and directed to Love their Neighbours. Accordingly Men following the impulse of Nature, and entering into Civil Societies, establish this first Standard of Justice, To live Honestly, to hurt no Body, and to give to every one his Right. It is the Right of Nature, saith the Law l. 205. F. de Reg. jur. that no Body enrich himself with the damage of another. And therefore we find that there is no Nation so depraved in their Manners, which doth not abhor and abominate ungrateful Persons, Murderers of Parents, Breakers of Covenants, Deceivers, &c. and think them worthy of the worst of Punishments, looking upon them as profest Enemies of Society, and violaters of the Law of Nature. How dismal would the condition of Mankind be, if it were lawful for every one to do what he listed, and to make his own Lust and Humour the Rule of Good and Evil? What House, what Palace would be secured from devouring Flames, if any one at pleasure might put Fire to them, and warm himself at the cost of another?

Y y y

What

vii.
How GOD hath imprest these Laws on the Mind of Man.

viii.
Men that deviate from these Laws are to be herded amongst Beasts.

ix.
The certainty of the Laws of Nature confirmed from the Relation Man hath to other Rational Agents.

X.
Man is
furnisht
with the
Idea's of
Good and
Evil, which
are such of
their own
Nature.

What *Wife* would be safe within her *Husbands Arms*, if there were no *Laws* to secure publick *Honesty*, and to guard the Enclosure of the *Conjugal Bed*? *Nature* hath deeply engraven this precept in the *Hearts* of all, *Do not that so another, which thou wouldst not have another do to thee*; this is that *Dicte*, which is present to all *Mens Minds*, and directs them, if so be they do not stop their *Ears* to its *Voice*, and listen to their *Passions* rather than their *Reason*.

From what hath been said, may be gathered, that there are some certain and immutable *Idea's* of *Good* and *Evil*, whereby, under the sole guidance of *Nature*, we distinguish things that are *just*, from those that are *unjust*, and things *honest*, from *filthy* and *unbecoming*: Like as by the different notations of *Figures*, we distinguish *Mathematical Schemes*, and separate them from one another. For as we define *Figures*, not by *Sense*, but by *Reason*; so we perceive what is *right* or *unjust* by *Reason*; which teacheth us that *Good* is to be desired, and *Evil* to be avoided. The ground whereof is this, because *Good* and *Evil* from whence our *Idea's* are taken, do not depend on the *Judgment* of any private person, or of any multitude of *Men* how great soever, but are such of their own *Nature*, and therefore necessarily to be embraced, or avoided by *Intellectual Creatures*. For as the *Understanding* of *Man* doth not enquire what appears to some to be *Truth*, but what is *Truth* simply and in it self: So likewise the *Will* of *Man*, doth not embrace that for *Good*, which seems to be so to some private persons, or to most *Men*, but what is really and immutably so, and which is to be chosen and embraced in spite of, and notwithstanding all the *Reluctance* of our *Animal propensity*. And therefore as there is something in *Nature* which is absolutely and simply *True*; so likewise must there be something that is good in its own *Nature*, and for its own worth and loveliness to be desired by the *Will* of *Man*. And therefore as he abuseth his faculty of *Understanding*, who being imposed upon by the deceptions of *Sense* or *Imagination*, doth not perceive what is naturally *True*; so in like manner he also abuseth his faculty of *Willing*, who suffers himself to be so blinded by his *Animal Appetite*, as not to chuse that which is good of its own *Nature*, and for want of due attention fails of his end and aim.

XI.
Some Sen-
tences into
which Mo-
ral Reason
may be re-
solved.

Now what *Method* or *Order* a *Man* is to follow in his choice, and what *Good* he is to embrace in such *Circumstances*, will appear from the subjoyned *Axioms*, into which the whole *Nature* of *Vertue* may be resolved.

1. That is accounted *Good*, which is agreeable to *Intellectual nature*, and is commensurate to its *State* and *Condition*, and is some way or other conducive to the *Conservation* of the perceiver.

2. On the contrary, that is accounted *Evil*, which is inimicitious or opposit to an *Intellectual Nature* with respect to its *Condition*, and causeth grief and aversion to it; and if it threatens its destruction, then is it esteemed to be the worst of *Evils*.

For one *Evil* supervening to another, is thereby made the more *Heavy*. For it is seldom seen faith *ALEXANDER* ab *ALEXANDRO*, that a *Commonwealth* shaken at once with intestine and foreign *War*, can hold out long; for the

superadded danger by dividing their *Councils* and *Subsidies*, which otherwise were scarce sufficient to stem its double *Tide*, makes them still weaker, and so at last over-throw the tottering *Commonwealth*.

3. All *Good* is not equal, as the *Stoicks* held, but some preferable to other, since it is certain that that *Good* is more excellent, which exceeds another in *Nature*, *Duration*, or both.

For it cannot be questiond but that *GOD*, who is *Eternal*, and who by his *Nature* includes all other *perfections*, must needs be a more excellent *Good* than the *Creature*, how perfect soever. And that an *Angel* in *Goodness* excells *Man* and *Beasts*. So that the value of *Good* may be considered after a twofold manner; either *Intensively*, as it affords the greatest satisfaction to the *Mind*; or *Extensively*, according to its more ample diffusion of the same, and its greater tendency to the *Good* of the *Universe*. From whence afterwards follows its *Duration*; for the more durable any *Good* is, the more excellent it must be also, and is so to be esteemed.

4. It is the peculiar property of *Good* to move the *Will* to the choice and embracing of it; whereas *Evil* produces the contray effect; and even as a greater *Good* kindles a greater *Love* of it self; so a less *Evil* is to be born, to avoid a greater.

Because a less *Evil*, with regard to a greater has the appearance of *Good*. Whence came that common *Axiom* amongst *Moralists*, that of 2 *Evils* the least is to be chosen. For seeing that *Nature* doth always what is best, therefore it also avoids the greater *Evil*; for a less *Evil* comes nearer to *Good*, and is accounted comparatively *Good*. Hence it is that *Men* to avoid being burnt, cast themselves from a *Precipice*, or leap into a *River* to avoid the *Jaws* of a *Wild Beast*, or the *Sword* of a *Robber*, and to keep themselves from perishing there, lay hold of *Thorns* or *Briars* or any thing how painful soever, to save their *Lives*.

5. If any thing happen to us, whose nature we are ignorant of, we may safely trust those, who profess themselves skilful in that matter; in case we are fully persuaded of their skill and faithfulness, and that it be evident to us, that there is no deceit in the matter, or desire of particular gain or advantage.

6. Tho' the event of things be doubtful, yet when ever we apprehend that any *Good* thing will happen, we ought to take as much pains to obtain it, as if it were present; since if we do so, it shall certainly come to be our lot at last.

7. In the judging and discerning of things, we are to take care that the *Mind* may be free from all the *Prejudices* of *Infancy*, and *Enticements* of our *Passions*; for the *Understanding* being clouded with the dark smook of the *Passions*, cannot discern the *Good*, and the *Will* following its guidance, mistakes in her choice.

These few *Sentences* or *Axioms*, are sufficient for the forming of *Ethical Demonstrations*, and for the begetting in us the 4 *Vertues* hereafter to be explained. And as to the *Duty* we owe to others, the same is comprehended in this general *Axiom*, *Whatsoever thou wouldst not have another do to thee, neither do thou to him*. Which is of as great extent and force in *Morals*, as *Charity* or *Divine Love*, (which comprehends all *Vertues* and *Graces*)

XII.
Our Duty
to others.

2





is in Divinity. Thus a Man, from the Command of GOD, considers his Neighbour, and learns to love him as himself: For in a like case, and in a like respect to GOD and his Law, a like Judgment must be made. If you think it unjust, that you should be robb'd or oppress'd by one more powerful than your self, by parity of Reason neither must thou thy self possess thy self of the Goods of one, who is too weak to resist thy Violence. And therefore this Law prevailed amongst the Romans, That the Right a man vindicates to himself against his Neighbour, the same may his Neighbour use against him. Because it is but just, that the same Measure a man measures out to another, should be measur'd to him again.

CHAP. IX.

Of Prudence; and the Parts of it.

I.
The Division of Vertue.

VERTUE is commonly divided into 4 Species, Prudence, Temperance, Fortitude and Justice, which Ethical Writers call Cardinal, because they consider them as the Hinges upon which all other Vertues turn, and from whence they proceed as so many Branches.

II.
The Nature of Prudence, and what it is conversant about.

The first Rank amongst these is given to Prudence, which makes use of all the rest, and as the Eye of the Soul doth point out to them their Order and Manner; and accordingly may be defined a firm and constant Will, heedfully to look out, and diligently to examine what is best. For it is the Office of a Prudent man, not to undertake any thing, which he hath not first weighed in the Balance of Reason, and found, that according to the present Circumstances of Place and Time, wherein he undertakes a thing, there is no truer, or at least more probable Reason, than that which he is resolv'd to follow. For Prudence is not a certain Science, which contemplates things necessary, and which can be no otherwise than they are; but a kind of knowledge that is conversant about Contingent matters, which are not only mutable, as to their Manner, but as to their Existence. For tho' the Object of Prudence generally consider'd be something common, viz. whatsoever ought to be done according to Right Reason; yet Prudence, as consider'd in every particular Man, is conversant about Singulars, which may, or may not be; or may be thus, or otherwise.

III.
The Three Duties or Offices of Prudence.

There be 3 Offices or Chief Acts of Prudence; Good and wary Consultation, Right Understanding or rather Judgment, and Sentence or Command. Consultation, or Deliberation, doth above all the rest belong to Prudence, whilst it considers what Means are most proper and best to obtain her End; to which is oppos'd Precipitancy, when we do things rashly and inconsiderately. And to the end this Consultation be such as it ought, it must be done with due Consideration, and aim at a good End; for otherwise it will be only Cunning and Craftiness. Right Understanding, or Judgment, is that whereby we pass a dextrous Judgment of the Means, by a reflex Act, approving of them. And is therefore called by ARISTOTLE, a quick and ready Understanding; to which is oppos'd dulness of Mind, or Folly: So that a Prudent man seems in some sort to keep the middle Station, betwixt a Block-head or Dull-fellow, and

a Crafty Knave. The Sentence, or the Habit of passing a Decretory Sentence, concerning the Goodness of the Means, follows next after Judgment, and is that whereby a Prudent man rightly determines, how to make use of the Means which he hath judged to be best, and with Constancy puts the same in practice.

Three kinds of Parts are assigned to every Vertue, the first whereof are Helps or Advantages, which are necessarily required to the Perfect Law of Vertue; the other are called Subjective Parts, which as so many Species do resort under it; and the last are called Potential, which Potentially are contained in the chiefest Vertues, and which do not comprehend their whole Natures, but belong to some Secondary Laws.

The Constituting parts of Prudence are,

1. To know the Laws of Nature, according to which we ought to live.

2. To compare them together, that we may know what place they must take, or which of them hath the Precedency.

3. To consider, and have regard to the Circumstances of place, time and persons, in all our Actions.

4. To have an Eye to our Chief End, and to pursue the same by all honest and lawful Means.

The Helps required to Prudence are reckoned 8 in number, viz. Memory, Understanding, Forecast, Teachableness, Quickness of Wit, Reason, Circumspection, and Cautelousness. Of which some are helpful to Consultation, others to Judgment or Discerning, and lastly, others to Sentencing or Determining.

Sharpness or Quickness of Wit belongs to Consultation, or Deliberation; by means whereof a Prudent Man finds out the Means, which conduce to the obtaining of his proposed End. This Help is of kin to Sagacity, which speaks a disposition in the Soul, whereby it readily and dextrously discovers what lies hid, and finds out the Ways which are the shortest and surest to the desired End.

Understanding, or Intelligence, is a Help to our Judgment or Discerning; and it is not here taken for a Habit of the first Principles; but for a knowledge of the things that ought to be done, whereby we perceive and judge rightly of things that offer themselves.

Teachableness is a Promptitude of the Mind, for the Learning of the things we are ignorant of: For seeing it is the part of a Prudent man to know many things, and to be able to distinguish the Honest Good, from the Pleasant and Profitable, it is necessary that he be Teachable, so as to improve himself by the Discourses of others, or in the Reading of Books.

Memory is that, whereby a Prudent man calls to Mind things that are past, and represents to himself several Actions and Events, from whence, as from the Premises, he concludes what Judgment he ought to pass of the future.

Reason is the right use of the Knowing Faculty, whereby a Prudent man, from fore-known and pre-consider'd things, argues aright, gathering and judging what he ought to do in present Circumstances.

IV.
Of the Parts of Vertue in General.

V.
Of the Constituting Parts of Prudence.

VI.
The Integral Parts of Prudence.

VII.
Sharpness of Wit.

VIII.
Intelligence or Understanding.

IX.
Teachableness.

X.
Memory.

XI.
Reason.

In

XII.
Forecast.
Circumspe-
ction and
Cautelous-
ness.

In order to *Command*, or the passing of a *De-cretory Sentence*, a *Prudent man* is assisted by *Forecast*, *Circumspection*, and *Cautelousness*: *Forecast* is that *Habit* whereby he diligently considers *Future things*, and from things that are past, gathers what will be, and accordingly resolves what to do. *Circumspection* is that *Habit*, whereby the *Circumstances of Affairs* are heedfully and diligently minded. And lastly, *Caution*, or *Heedfulness*, is that whereby *Obstacles* that might happen are removed, and all *Impediments* that might hinder the obtaining of our intended End.

XIII.
The Subje-
ctive Parts
of Prudence

The *Subjective parts* of *Prudence*, according to the *School-men* are 4, viz. *Private* or *Solitary Prudence*, *Oeconomical*, *Political*, and *Military*.

XIV.
Wherein
Private
Prudence
doth consist.

Private Prudence, tho' it be frequently confounded with the *Monastick*, yet is it not peculiarly to be restrain'd to those that lead a *Monastick Life*; and separating themselves from the *Multitude*, betake themselves wholly to *Contemplation* and *Devotion*; but is that which belongs to every *Singular Man*, who, whether he hath none to take care of but himself, or whether he takes care also for others, stands in need of *Prudence*, to direct and assist him in his several *Actions*.

XV.
The First
Office of
Private
Prudence.

The *Office of Private Prudence* is twofold; the First, That every one do chuse some kind of *Profession* or *Way of Living*, wherein he may spend the rest of his *days*: For no *Man* can be happy that keeps no certain *Course of Life*, but being unresolv'd and wavering, is ever deliberating what *Condition of Life* he had best embrace, and to what *Order of Men* he had best joyn himself. *Prudence* therefore adviseth every *man* to consult his own *Genius* and *Ability*, and to chuse for himself such a *State of Life* as comports with his *Natural Gifts*, and the *Temper of his Mind*, and wherein he may with *Pleasure* and *Satisfaction*, continue throughout the *Course of his whole Life*.

XVI.
The other
Duty of
Private
Prudence.

The other *Duty of Private Prudence* is, that having once pitch'd upon a set *State or Condition of Life*, he use all possible *Industry* that he square all his *Actions* by the *Rules of Vertue*, according to the *Dictates of Reason*; and take heed to commit nothing that may necessitate him to *Repentance*. All which he may, without any great difficulty obtain, in case he undertake nothing without mature *Deliberation*, and be constant and firm in his *Purpose*, when once he is assur'd of the *Goodness* and *Honesty* of them. For the chiefest part of *Human Beatitude* consists in *Acting constantly*, and never turning aside from the *Right path of Vertue*.

XVII.
What Oeco-
nomical
Prudence is

Oeconomical Prudence is, that whereby a *man* orders the *Concerns of his Family*. Its *Dictates* are, that no *man* rashly or inconsiderately cast himself into the indissoluble Band of *Matrimony*; but that he consider well of it before he enters a *State*, which he cannot quit again at his pleasure. That the *Woman* he takes to be his *Wife*, be adorned rather with the *Embellishments of Mind*, than of *Body*; and that she be more recommendable by her *Chastity* and good *Manners*, than by her *Riches* or *Portion*. Also, that there be an *Equality* between him and her, since it is a common thing for a *Wife*, who is above her *Husband* in *Nobility* or *Riches*, to despise him, and look

upon him rather as her *Servant*, than her *Husband*. *Prudence* also adviseth, that he seriously weigh and consider the *Temper of Women*, the *defects* and *weaknesses* they are subject to, and that their *Will* is commonly much stronger than their *Reason*, and their *Phancy* and *Humour* the *Law of their Actions*: That many *Husbands* have only 2 good and pleasant *Days*, as *HIPPONACTES* saith by *STOBÆUS*, the one, that of their *Marriage*, and the other, that of their *Wives Burial*: That being once married, he must treat her as his *Wife*, by communicating his *Secrets* unto her; especially if he knows she can hold her *Tongue*, and conceal what ought not to be divulged; lest she should conceive her self to be slighted or neglected, and by this means becomes careless of her *Duty*.

Prudence also prescribes *Rules*, how *Children* ought to be *Educated*, and *Servants* kept to their *Duty*; which it would be too prolix to insert here, and may be seen set down at large in a *Treatise* which I have written in *French*, concerning *Vertue*, conformable to the *Sentiments of Epicurus*, entituled *L'Epicure Spiritual*.

Political, or *State Prudence*, imitates the *Oeconomical*, and differs from it only in this, that its *Subjects* are more numerous: For as the former is concern'd with governing ones *Wife, Children* and *Servants*; so *Political Prudence* consists in *Ruling a City, Province, or Nation*. In order to the discharging of which *Function* aright, it is first necessary that he who bears *Rule* over others, do himself excel in *Vertue*, that his *Actions* may serve for *Examples* to his *Subjects*. For *Subjects* think it their *Glory* to imitate the *Manners of their Prince*, and to express him in all their *Actions, Words* and *Gestures*. Hence it is, that the *Crimes* and *Vices of Princes* spread like a *Contagion*, and infect the whole *Body of their Subjects*: For they think, that what their *Princes* do, is not only lawful for them, but even *Praise-worthy* also; so dangerous are great *Examples*, and so effectual for the promoting of *Vice* and *Wickedness*. He therefore that *Governs* others, must carry a *Majesty*, and command *Respect*, not by his *Big and Severe Looks*; but by the *Rectitude of his Manners* and *Heroical Vertue*.

As it is highly commendable for *Princes* to be *Religious*, and *Eminent* in their *Piety* towards *GOD*; so must they also excel in punctual *Faithfulness* and *Truth* towards their *Equals*. For a *Prince* that doth not keep his *Word* and *Promise*, makes himself *Vile* and *Despicable*, because it is a mark of *Fearfulness* and *Impotence* to break his *Word*, and to elude the *Execution of his Treaties*. *Prudence* therefore adviseth, that a *Prince* be exact in performing of his *Word*, and just and equal in his *Actions*. For *Rulers* are not exempt from, or above all *Laws*, for *Justice* is above them; and if it be in their power to do what they please, yet are they not to will any thing, but what they ought. It must be also a great part of their *Care*, to have an *Eye* to the *Great Officers* and *Magistrates* under them, to see that they perform their *Duties*, to the end that the *Judges* may be *Honoured*, the *Laws* *Reverenced*, and they themselves *Loved* and *Dreaded*.

Military

XVIII.
How Chil-
dren and
Servants
are to be
ordered and
Governed.

XIX.
The Pro-
cepts of Po-
litical or
State Pru-
dence.

XX.
Princes
must be Re-
ligious, and
true to
their
words.

Boetius. Part. 10. Chap. 10.



XXI.
What Mi-
litary Pru-
dence is.

Military Prudence, which chiefly belongs, and is necessary to the *Commanders in Chief of Armies*; teacheth how to undertake a *War*, carry it on, or bring it to an happy Issue: First, by instructing them not to enter upon it rashly, and without good Advice; having first well weighed their own *strength*, and being moved to it by a just Cause. For if they find, that the *Power* they intend to oppose will prove an over-balance for them, *Prudence* will advise them to desist from the Thoughts of attacking a too Potent *Enemy*, and to conclude a *Peace* with them, rather than hazard the Loss or Ruin of their *Kingdom*. But if *Peace* cannot be had but upon unreasonable Conditions, then a *War* is to be hazarded; and after having implor'd the Divine Favour by *Prayers*, and encouraged the *Souldiers*, they are to give Battle, and to dye rather, than to lose their *Right* and *Liberty*.

XXII.
What things are necessary for the waging of War.

In the waging of *War*, great care is to be taken, first, to Lift strong and couragious *Souldiers*, Exercis'd in *Arms*, and hardned to Labour and Service. Secondly, That they be well Arm'd, not only with *Defensive*, but also *Offensive Arms*. Thirdly, That a sufficient Quantity of *Provisions* be provided, and ready at hand, for the supply of the *Army*, seeing that for want thereof; not only *Castles* and *Towns* are often lost, but whole *Armies* sometimes miscarry. Fourthly, That there be store of *Mony*, which is the *Sinews* of a *War*, and without which the *Souldiers* cannot be kept to their *Duty*, nor restrain'd from *Robberies*. These 4 things being well fore-cast and provided, *Princes* or *Generals* may safely undertake a *War*, and Invade their *Enemies*, since this is all that *Military Prudence* requires, in order to the Successful carrying on of a *War*.

XXIII.
Prudence is acquired two several ways.

From what hath been now said, it is easie to conclude, that the ways of acquiring this *Vertue* of *Prudence*, are reducible to 2 only, viz. to *Precepts* and *Experience*. The latter of which is twofold, viz. ones own *Experience*, and that of another. Proper *Experience* is the knowledge of things, that we our selves have seen or done; and the other is the knowledge of things, that have been seen or done by others, and which we have only by Relation. The *Prudence* we get by *Experience* and *Use*, is much more sure and certain, than that which is attain'd by *Precepts*, or by the knowledge of *History*; but as it is more excellent, so likewise it is more difficult to be obtained.

CHAP. X.

Of Temperance.

I.
About what things Temperance is conversant.

TEMPERANCE is so nearly ally'd to *Prudence*, that it always accompanies it, and seconds it in all its *Laws*; and was therefore called by the *Ancients*, the *Conservatrix* of *Prudence*, because it preserves the Soundness of the *Mind*, and is very conducive to Consultation and Judgment. For an *Intemperate* person seems to have suffer'd Shipwrack of his *Reason*, and therefore pught to be serv'd as *Mad-men* are, in order to the Recovery of it. For *Temperance* imports nothing else, but the Moderation of *Reason*, and the absolute Command of the *Soul* over all its *Passions*: For it suppresseth *Concupiscence*, stifles vain

Hopes, moderates *Love*, and keeps the *Mind* from being ruffled by any other Perturbations whatsoever. But being taken in a stricter Sense, it signifies the restraint only of those Pleasures which belong to the *Taste* and *Feeling*, which are common to us with the *Beasts*; and to which, according as *Men* either addict themselves, or bid defiance, so they are termed *Temperate* or *Intemperate*.

We may therefore define *Temperance*, A firm and constant Will or Resolution, to resist and restrain Bodily Lusts and Pleasures, especially those that belong to the *Taste* and *Touch*. By which words it appears, that those Pleasures are excluded which belong to the Senses of *Seeing*, *Hearing*, and *Smelling*; and that *Temperance* in this Sense, is only conversant about the pleasures of the grosser Senses of *Tasting* and *Touching*.

The Parts which in some sort may be said to constitute *Temperance*, are *Honesty* or *Decency*, and *Bashfulness*. For there is a kind of Comeliness beaming forth from *Temperance*, which allures men by its Loveliness, and makes them to restrain and repress flattering Pleasure, and to deny whatsoever is most pleasing to the *Body*. For it is a commendable thing to avoid all *Immoderateness*, and to follow *Temperance* only for the Comeliness and Loveliness of it. *Bashfulness* also is a great help towards the exercise of this *Vertue*; whereby we fear *Infamy*, lest by indulging our Lusts, we should expose our selves to shame, and lose our Fame and good Repute by our *Intemperance*: for *Shamefacedness* or *Bashfulness*, is not here taken for a *Passion*, but for a kind of Fearfulness of incurring Reproach and Disgrace, by committing any shameful Action; which Fear of Shame may well be called the Guardian of *Vertue*, as being always accompanied with a laudable Moderation.

There be 2 Species of *Temperance*, viz. *Sobriety* and *Chastity*, the former whereof moderates our Eating and Drinking; the latter sets Bounds to the Enjoyment of a *Conjugal Bed*.

Sobriety teacheth us, that our Bodies are contented with a little, and cannot without Pain and Prejudice bear what is superfluous. And accordingly hath given us a Measure, by which every one may be informed what quantity of Meat and Drink he ought to use. For Nature being a Careful Mother of her Children, condemns all those things that serve to tempt and provoke an Appetite, and which are taken rather for Pleasure, than for Necessity; and teacheth us by daily Experience, that Diseases and Infirmities of the Body, are the Fruits of *Intemperance*, and that Pains and Dulness of the Head, Crudity of the Stomach, Gripping of the Guts, would be in a great measure unknown to Men, if they did not by Drunkenness and Gluttony pull them down upon themselves. Whereas on the contrary, *Sobriety* secures the Body, restores decayed Strength, and by reducing the Humours to a due Temperament, easily subjects the Passions to Reason. Do we think that he is wholly depriv'd of Pleasures; whose Diet are the Fruits of the Earth, and contents himself with Viands that are prepared without the need of a Cook? Such an one as he enjoys a vigorous and healthful Constitution of Body, in which his Soul exerciseth her Functions freely and expedirely:

Z. Z Z Z

II.
The Definition of Temperance

III.
Decency and Bashfulness do constitute Temperance

IV.
Sobriety and Chastity are the two Species of Temperance.

V.
The Precepts of Sobriety.

So

So *Abstinence* to him is instead of the most delicious *Liquor*, as preserving his *Health*, and fortifying it against all *Infirmities*. Wherefore we must accustom our selves to a Moderation in *Diet*, if so be we would enjoy a sound *Mind*, in a *Healthful* and sound *Body*. And this will be our portion, if contenting our selves with Common *Food*, we shall despise *Dainties*, except only so far as may be necessary for the Recovering of our *Health*, and to comply with the Advice of our *Physician*: Since nothing is more sure than, that *Meats* are spoiled and adulterated by too much care and exquisiteness in *Dressing*; and that the Art of *Cookery*, for the most part, leaves them more unwholsom than it found them.

VI.
By what
means
Chastity
may be pro-
cured.
First by a
Spare and
Abstemious
Diet.

And as for *Chastity*, which permits no *Pleasures*, besides those that are enjoyed in Lawful *Wedlock*, it will be of use to set down some *Preservatives*, whereby a *Man* may secure himself against the violent Attacks of *Carnal Lust*, and render *Chastity* easie and familiar to himself. The First and Chiefest of these *Preservatives* is, that he use a slender *Diet*, and carefully avoid all *Meats* and *Drinks* that are enflaming. For it is very hard, or rather impossible, for a *man* to indulge himself in *Gluttony*, and not to be tormented with *Lustful motions*. For *Gluttony* and *Carnal Lust* are so closely ally'd, that, as *TERTULLIAN* hath it, *Lust* without *Gluttony*, may well pass for a *Prodigy* or *Monster*. Let the *Body* therefore be fed with that *Caution*, that the *strength* of it only may be preserved, without furnishing *Copious Matter* to increase a *Passion*. *Food* is afforded us for the maintenance and support of our *Bodily Lives*; and tho' it be necessary to our *Nature*, yet is it to be taken with care and anxiety, lest it should supplant our *Chastity*, and excite us to *Uncleannefs*.

VII.
Secondly by
Business
and Em-
ployment.

The *Second* *Preservative* is, that he be always busied and employ'd in some honest *Calling*, without indulging *Sloth* or *Idleness*: For continual *Business* or *Study* waists the *Animal Spirits*, which invigorate us; or at least by taking up the *Mind*, divert it from *Lustful Thoughts* and *Imaginations*. *Idle persons* are most haunted with this *Spirit* of *Luxury*, and such who by doing nothing, learn to do *Wickedly*. We must take *Care* therefore to eschew *Idleness*, and to entertain our *Minds* with such *Thoughts*, as are so far from being *Incentives* to *Lust*, that they are destructive of it.

VIII.
Thirdly by
avoiding
the Tempta-
tion.

Thirdly, It will be of good use to avoid and fly from the *Temptations*, which may come from the *Sight* of, and too free *Discourse* with *Women*, lest by handling *Pitch* we be dawbed with it. For *Lust* is better conquer'd by *Flight*, than by *Fight*.

IX.
Fourthly an
obstinate
Resolution
of Resisting
Temptati-
ons.

Fourthly, A full *Resolution* and long contracted *Habit* and *Custom*, to repel the *Assaults* and *Onsets* of *Lust*, is very advisable: For as he is easily overtaken with *Lust*, who hath been often conquer'd by it: So he who makes it his business strenuously to resist its *Temptations*, becomes thereby the more strong and vigorous to resist them. I confess, it is a *Master-piece* to overcome so smiling and fawning an *Enemy*, which whilst she ruins, seems to *Care* us. But what is all this, if compared to our *Strength*? Nothing is impossible to a *Soul* that is resolved to conquer: They are

Cowards that upon the first *Onset* give way, without ever putting their *Strength* to the *Trial*. But you'll say, It seems impossible, all on a sudden to quit a *Habit* of long standing: Suppose it so, Disaccustom your self by little and little, contain your self for a few *Days* at first, and afterwards by degrees protract the said *Time*, and question not, but that by frequent *Fights* and *Resistings*, you will at last become *Conquerour*. Call to mind, how great and sincere a *Fey* thou hast been sensible of, whenever thou hast shewed thy self a courageous *Combatant*, in resisting and putting by these *Assaults*; and on the contrary, how thou hast been cast down; what *Shame*, what *Repentance*, what *Anguish* have pinch'd and rack'd thy *Soul*, whenever thou hast weakly and cowardly made thy self a *Slave* to thy *Beastly* and *Inferiour Nature*. In a word, thou wilt soon be *Chaste*, if thou canst once heartily Will to be so.

Temperance likewise hath its *Potential Parts*, viz. *Meekness*, *Clemency*, and *Modesty*. The business of *Meekness* is, to restrain *Anger*, and to refrain the *Mind* from *Revenge*. For by means of this *Vertue* a *Man* becomes truly *Human*, and lovely in the sight of others. For as he is *Hateful* and *Troublesom* to all, who is easily provoked to *Anger*; and who, upon the least occasion, becomes enflamed with *Wrath*; so on the other hand, we love and delight in the Company of those, who, tho' highly provok'd are easily reconcil'd, and forgive the *Injury* done to them.

Wherefore we must take care to moderate the impetuous *Flame* of *Anger*, and to quench it by *Meekness*, that we may come to our selves again, and recover the possession of our *Minds*, whence that violent *Passion* had turn'd us out. Wherefore, as soon as any one finds himself mov'd to *Anger*, let him consider how contrary this *Passion* is to *Humanity*, and how shamefully it disguiseth his *Body*, and casts down the *Soul* from its *Throne* of *Power* and *Command*. Consider the Looks of an *Angry man*; his *Eyes* flame, the *Blood* comes up into his *Face*, boyling up from his *Heart*, he Faulters in his *Speech*, his *Face* is distorted and dreadful; so that it is a great *Question*, whether this *Vice* be more detestable in its *Nature*, or more ugly in its outward *Appearance*. Let a *man* consider also, what a *Man* gains by all his *Rage* and *Wrath*; whereas by refraining his *Anger*, he delivers himself from this dreadful *Commotion* and *Concussion*, which has prov'd fatal to many, whilst they have endeavour'd to wreak their *Spleens* upon others. How much more glorious is it, to bear *Injuries* patiently, and to contemn *Affronts*, rather than to meditate a *Revenge*; and whenever we perceive this *Enemy* creeping upon us, to have that of *MARK ANTONINE* the *Emperor* always before the *Eyes* of our *Mind*. Behold one thing here that is highly to be valued, to *Converse* courteously with *Truth* and *Justice*, amongst a *Company* of perverse and lying *Men*.

Clemency is near of Kin to *Meekness*, which is that *Vertue* whereby the *Mind* is inclin'd to *Forbearance* and *Forgiveness*, rather than to *Punishment*, and that according to right *Judgment*. This is a *Vertue* that well becomes a *Prince*, who like *GOD* ought to be ready to *Forgive* the *Offences* of *Men*; as it is express'd *L. Imperialis de Nuptiis*. For as the *Top* of the *House* does keep off the

X.
The Pot-
ential Parts
of Tempe-
rance.

XI.
The Horrid
Effects of
Anger.

XII.
Clemency.



Book 1. Part 30. Chap. 33.



*To the Worshipfull
of the Middle*

This Plate is humbly



*Simon Harcourt
Temple London Esq.*

Dedicated by Richard Blome

the Assaults of *Wind* and *Weather*; so it is the Duty of him, who is the Head of the *Government*, to provide for the Safety of the whole *Body*. *Kings* indeed have the Superiority and Dominion, but it is for the sake of *Men*; not as meer *Arbitrary Governours*, but rather as *Guardians* and *Administrators*, to whom the *Commonwealth* is committed by *GOD*, to cherish and defend it, and take care for the Safety of it.

XIII.
Modesty.

Modesty is conversant about the moderation of the desire of *Dignity* and *Honour*. He deserves the name of a *Modest Man*, who doth not boast of his *Merits*, or vaunt of his *Endowments*; but owning himself to be a *man*, thinks lowly of himself, and esteems nothing properly to belong to him, besides that which he hath attained to. And accordingly a *Person* adorned with this *Vertue*, is more solicitous about rendering to others the *Honour* that is due to them, than desirous to receive the same from others; and is much more carried to the performing of good and great *Actions*, than concerned to obtain the name and esteem which gallant *Achievements* bring along with them.

XIV.
The Duty of a Modest Man.

Whosoever thou art therefore, that art raised to great *Honour*, entertain no high thoughts of thy self, but being conscious of thy *Human Frailty*, and mindful of thy *Mortal Condition*, suspect and reject every thought that would flatter thee into a high conceit of thy self. A man famous for his *worth* and *merit*, and whose *Soul* is embellish'd with *Vertue*, must resemble an heavy *Ear of Corn*, which sinks its *Head* by so much the *Lower*, as it contains a greater number of *Grains*. For the least *Boasting* lessens *Merit*; and as *praise*, coming from a *mans* own *mouth*, is nauseous, so the proclaiming of ones own *vertue*, obscures the *Glory* that is due to it. When *CATO* was asked why the *Senate* had refused to erect his *Statue* in the publick place, he answered, that by their refusal they had taken more care for his *Glory*, than they would have done in allowing him a *Statue*, for that he would much rather, that *men* should enquire why the *Senate* had not erected his *Statue*, than demand why they had *honoured* him with one in the *Market Place*. For *Honour*, like a *Shadow*, follows those that flee from it, and is most found in their company who do not pursue it. Wherefore, a *Wise Man* that placeth his happiness in the exercise of *Vertue*, is always unmoveably resolv'd, never to prefer himself before any one, forasmuch as by this neglecting of *Honours*, he both secures his own *Peace*, and acquires the most solid and greatest satisfaction. But then this *Modesty*, or rather *Humility*, must be sincere and without dissimulation; and far from that *Ambitious Lowliness* of some *Philosophers*, who by their despising of *vanities*, sought for vain *Honour*, and as *STOBÆUS* saith of them, trampled upon the *Pride* of others, with a greater *Pride* in themselves.

CHAP. XI.

Of Fortitude.

I.
Fortitude exceeds all other Vertues: The Definition of it.

TH O' all the *Vertues* be worthily esteem'd by *Moralists*, and engage *Spectators* to love them; yet there is none amongst them all, which more insinuates it self into their *hearts* than *FOR-*

TITUDE, or that shines with a more distinguishing Beauty and Lustre. *Justice* is had in great *Honour*, and the *Princes* and *Magistrates* that pursue it, do by this means attain to a high degree of *Veneration*. *Prudence* is the very *Soul* of *Statesmen*, and is industriously studied and sought for by all who have the care of *Families*, or the *Government* of a *Commonwealth* committed to them. *Temperance* hath many that praise and love her, because of the *Pleasures* she affords her followers, as well as by reason of her Comeliness, whereby she recommends her self to the *Eyes* and *Hearts* of her very *Enemies*. But yet all these *Vertues* do in a manner vanish and disappear when *Fortitude* presents her self, as the *Stars* at the rising of the *Sun*; for her powerful Beauty, at first sight, charms and ravisheth our *Hearts*, which, as *SENECA* saith, consists in her not dreading the *Fire*, in her receiving of *wounds*, and being so far from avoiding the *Darts* level'd at her, that she meets them, and exposeth her *Breast* to them. So that *Fortitude* may be defined, a *Constant purpose of Mind* to undergo *Dangers*, and endure *Pains* and *Labour*, when-ever we think them to be best. Its chief *Laws* are two, the one whereby she commands us to *Undertake*, the other whereby she teacheth us to *Endure*: For seeing that this *Vertue* is conversant about *Boldness* and *Fearfulness*, which are 2 extremes of it; it suppresseth *Fear* by enduring *Difficulties*; and moderates *Boldness*, by a cautious undertaking.

II.
About what things Fortitude is conversant.

Wherefore to this *Vertue* in general, is required, first a kind of *Firmness* or constancy of *Mind* against all those *ills*, which we look upon as hard or difficult to undertake or endure. For a *man* cannot be lookt upon as possessor of this *Vertue* for excelling in *Bodily Strength*; forasmuch as those who want that, may nevertheless be adorned with this *Vertue*, which consists chiefly in a firm purpose of performing those things we judge to be honest, and of wrestling against all *Adversities* without being discouraged by them, with an even temper and firm resolution.

III.
Who it is that deserves the name of a Valiant Man.

It hath been said already, that the *ills* which a *Valiant Man* is to cope with, must be great and difficult; for if they be matters of no trouble, they are not so much the object of this *Vertue* as of *Expectation* only. The *Second* thing required to *Fortitude* is, that it be not the effect of *Rashness*, but that it be done for a good end. For he is undeservedly called a *Valiant Man*, who by a blind impulse, and without any regard had to his own strength, ventures upon any thing, and who rather dares and provokes *Dangers* than fears them: but he, who after a due weighing of the *Dangers* he is about to engage in, tho' he doth not love them, yet undergoes them with an undaunted *Heart*, and endures all things when, and how it best becomes him. Hence it is that *SENECA* defines *Fortitude* to be the *Science* of distinguishing what is *Evil*, and what is not. Forasmuch as this *Vertue* is not any inconsiderate *Rashness* or *Foolhardiness*, nor a love or desire of *Dangers*, but the knowledge of undergoing and overcoming *Dangers*. So that *Fortitude* is made up of these 2, viz. *Honesty*, which this *Vertue* must always have for her end and aim; and *Cautelousness*, or weighing of the *Danger*, before she undertake to grapple with it.

Moralists

IV. Magnanimity, Magnificence, Constancy and Patience are commonly confounded with Fortitude.

Moralists commonly divide *Fortitude* into 4 Species, viz. *Magnanimity*, *Magnificence*, *Constancy* and *Patience*. But all these have so great an agreement with *Fortitude*, that they differ from it by some conditions and circumstances only. For *Magnificence* imports only a circumstance of the *Danger*, that is to be ventur'd upon, as being supposed to be illustrious, and to the overcoming whereof *Glory* and *Splendor* is annext. *Magnanimity* intimates that *generosity* and greatness of *Soul*, which is necessary to the undertaking of dangerous enterprises, or the enduring of Labour. *Constancy* implies a kind of *Perseverance*, whereby the *mind* is confirmed to stick to its intended purpose, and never basely or cowardly to give it over. Lastly, *Patience* superadds nothink to *Fortitude*, save only that it is rather conversant about the enduring of *Evil*, than in the undertaking of difficult and dangerous performances, and rather suffers, than acts. Wherefore not to insist any longer on these, we proceed to the consideration of those *ills*, in the overcoming whereof the *Glory* of *Fortitude* doth chiefly consist; and these are either Publick or Private.

V. How Publick Ills are to be born and overcome.

Publick Evils are, the *Destruction of ones own Country*, *Famine*, *Plague*, *War*, &c. which we shall be enabled to overcome, by considering that they are not *Evils* in their own nature, but are made such only by our opinion of them: that *Empires* and *Commonwealths* are subject to Vicissitudes, and that nothing is *Eternal* in this *World*. That we are to be affected towards our *Country*, that when we find we can no longer serve it, or be of any advantage to it, we do not hurt our selves; and that when we see the whole cannot possibly be saved, that at least we endeavour to rescue a part of it. What reason have we to be so much surprized and astonished at any such change, since it is natural for that thing to have an *End*, which had a *Beginning*. It is the *Eternal* decree of *Heaven*, that all *Temporal things* must fall, all corruptible things haste away, and all changeable things perish. We shall no longer be amazed to see a *Kingdom* overthrown, when we consider that the whole frame of this *World* must be dissolved. Wherefore when we see that we can no ways procure our *Countries Liberty*, let us at least endeavour to secure our own, and that if we must dye with it, its ruin may oppress us undaunted and without pusillanimous fearfulness. And Lastly, forasmuch as we are assured that all things are ordered by an unerring decree of *Providence*, the *Love* of our *Country*, must give way to our *Love* of *God*; and our *Human Wisdom* become subject and captivated to the *Eternal* and *Infalible Decree* of the *Great Creator* of all things.

VI. A Man endued with true Fortitude, doth easily overcome Private Ills.

As to *Private Evils*, such as *Imprisonment*, *Poverty*, *Shame* or *Ignominy*, &c. tho' they may seem to some to be hard to bear, yet doth a *Valiant Man* easily despise them, as knowing that these things are only *Evil*, according to the opinion of the *Vulgar*, and that they are afflicting, because we take them to be so. For what great *Evil* is there in a *Prison*, that it should afflict a truly great *Soul*? Is it because he is kept from the company of his *Friends*, and, as it were, excluded from the *Society* he is a member of? But a *Wise Man* knows that a wrongful *Imprisonment*,

is much better than undeserved *Liberty*; and that it is infinitely more eligible to suffer for *Equities* sake, than, by wicked means, to abound with *Riches* and *Honour*. Others consider a *Prison*, as a *Retirement*, where, tho' the *Body* be kept in, the *Mind* may have its unrestrained Flight, and take its unbounded walks in the infinite spaces of *Eternity*. Who would think himself to be a *Prisoner*, as long as he may betake himself to the *Market*, to the *Senate*, to *Heaven* it self, and divert himself amongst the *Stars*? Have not some writ Books in *Prison*, and others attain'd *Learning*? If to wicked and foolish men it be the *Devils House*, in which he keeps his *Family*; to a *wise man* it becomes the *School of Vertue*, where, without impediment, he dedicates himself to *Piety* and *Probity*. Why should a *man* abhor a *Prison*, who hath been conceived in a *Dungeon*, and thence borrowed the beginning of his *Life*; and who, after he is born, is confined to the *Prison* of his *Body*, till it return to the *Earth* from whence it was taken?

The loss of outward Goods seems to inflict a deeper wound, which yet a *wise man* is very little sensible of; who considers all the things of this *World*, as the furniture of a *Lodging* in an *Inn*, the use whereof, for a short time is afforded him, without any right of *Possession*. The loss of *Riches* is frequently the happy Mother of *Peace* and *Quiet*, and a *Tranquility* of *Mind*, which is seldom enjoy'd but by a *Soul* free from *Earthly Cares*. ZENO, the Father of the *Stoicks*, called that day the happiest day of his *Life*, wherein he lost all his *Goods* by *Shipwrack*, and profest himself extremely engaged to those *Winds*, which, by casting the *Ship* wherein his *Estate* was contained, against the *Rocks*, had driven him into the safe *Haven* of *Philosophy*, where he spent the rest of his *Life* at the furthest distance from the *Storms* and tossings of this *World*. A truly *Valiant man* therefore knows that he hath no *Right* to any of these outward things; no more than the *Earth* can lay claim to the *Light*, which ariseth and disappears again in a moment. He calls to mind, that all the conveniencies he enjoys here are the *Divine Benefits*, which as they are freely granted, so are they taken away again, for just tho' hidden causes.

But your *Enemies* take away your *Good Name*, and endeavour by all means imaginable to obscure and blacken your *Reputation*. Neither can this reach any but weak and Pusillanimous Persons, who not considering the *Talkativeness* of wicked and perverse men, are too much concern'd with their *Babbling*. But the *man* that is possesst of true *Fortitude*, undervalues all these things, and as he despiseth *Pride*, so he is little concern'd at what men say of him, as long as he is conscious to his own *Probity*: He is a sufficient *Theatre* to himself, who esteems it to be a *Kingly* part to do well, and to be ill spoken of. Was there ever any *Good man* that escaped the *Slanders* and reproaches of men? The *Tongue* of *Backbiters* creeps in every where, not sparing *Sanctity* it self. Let every one therefore that is assaulted by the *Tongues* of malevolence consider with himself, whether he be guilty of the *Evil* that is reported of him, or not; if he be not, what reason hath he to be concern'd at the imputation of this *Slanderer*, or to vex himself, because

VII. A Valiant Man endures the loss of outward things, and a Wise Man wishes for none.

VIII. The loss of a Good Name or Reputation may be easily overcome like a wife.



G. Freeman In.

I. Kip. Sculp.

~ To the Worship-
 ~ Portman of
 ~ County of
 ~ This Plate is humbly



~ full Henry
 ~ Orchardiny
 ~ Somerset Esq.
 ~ Dedicated by Rich: Blome

because a malevolous person useth the liberty of his *Tongue*, and complies with the perverseness of his own Nature? But if he be guilty of the Reproach laid at his Door, let him immediately take occasion thereby to amend his *Fault*, and by changing his *Life*, prevent, as much as in him lies, all occasions of *Reproach* for the future. Let him seriously consider, that all that is said is without him, and cannot enter his *Breast*, except that he himself admit it, since no man is, or can be offended but by himself.

IX.
How all
other Evils
are to be
obviated
by us.

And because the limits I have confin'd my self to, do not allow me to reckon up all particular *Evils*; I shall only prescribe this general *Remedy* for them all; that a *man* thoroughly persuade himself, that the *Peace* and *Tranquillity* of his *Mind* doth not depend on *Riches*, *Honours*, *Friends*, *Health*, and other good things so accounted; since many are miserable notwithstanding the enjoyment of all these, and many are happy without them. How inconsiderable is the loss of *Money* to him, who hath laid up his *Treasure* in *Heaven*? And how little is he concern'd with being banisht from his own *Country*, whose *Heart* is fixt on a *Heavenly*? What hurt is it to have ones *Body* bound, as long as the *Mind* is at full liberty? A truly valiant *man* is always the same; and as a *Hand* that is spread, or clutch'd into a *fist*, continues still the same *Hand*; so he bears the same *Mind*, and looks too, in the blustering dark *Storms* of *Adversity*, as in the serene *Sunshine* of *Prosperity*: For *Death*, *Diseases*, the loss of *Goods*, *Fame* and *Friends*, and other such-like that appear so terrible to some, are the *Tributes* due to *Nature* or *Fortune*, and are to be paid by us, whensoever they are demanded. How much more glorious therefore is it, to put a difference between our *Soul* and *Body*, and to keep our *Soul* free and unconcerned, tho' our *Body* be pain'd with *Aches*, shut up in a *Dungeon*, torn by an *Executioner*, and assaulted by *Death* it self.

X.
Some kinds
of false
or seeming
Fortitude.

As there are 4 kinds of true *Fortitude*, so there are 5 of that which is False and Appearing. The First whereof is the *Political* or *Civil*, which by fear of *Punishment* or *Shame*, or the hope of *Honour*, prompts *Citizens* to the undergoing of *Dangers*. 2ly. *Military*, whereby men relying upon their *Strength* or skill, or for hope of reward, cast themselves upon hazarding their *Lives* and *Limbs*. 3ly. *Angry* or *Wrathful*, whereby men, inflamed with *Anger*, venture upon the most desperate and dangerous attempts. The 4th. is *Experimental*, being proper to those, who having escaped many great and eminent *Dangers*, are confirm'd in a hope of a like good luck in the most dangerous undertakings they set upon. The 5th. is a *Blind* and *Ignorant* *Fortitude*, whereby men continue undaunted, because they are not sensible of the danger they are in. But none of all these is that true *Fortitude*, whereof we treat here; for a truly valiant *man* acts wittingly, knowingly, constantly, only out of *Love* to *Vertue*.

CHAP. XII.

Of Justice.

THO' JUSTICE be esteemed the Splendor of all other *Vertues*, and the Root of all *Duties* or *Offices* whatsoever, yet doth it derive its excellency only from the *Corruption* of men, and takes its rise from their *Vices*. For as we must first discover the *Disease*, before that we can be in a condition to *Cure* it; so *Laws* are made use of for a *Check* and *Curb* to *Vices*, and to bind depraved *mankind* to their good behaviour. For *Justice*, according to the account the *Lawyers* gives us thereof, is nothing else but a constant and perpetual *Will*, of giving to every man his due, L. 10. F. de Just. & Jur. By the word *Will*, in this definition, we do not understand that *Faculty* of the *Mind*, whereby it determinates it self to act, and assents to a thing clearly perceived by it, but rather the *Affection* or *Purpose* of constantly exercising *Justice*. Because he is not said to be *Just*, who simply doth that which is *Just*, when his chief motive is either *Fear*, or to obtain the favour of *Friends*, or the hope of *Reward*, or other such like; but he only who performs such actions from his own free will, and out of *Love* to *Justice*.

I.
Of the
Nature of
Justice, and
whence it
hath its
Rise.

It is also added, that this *Will* or *Purpose* must be perpetual; for it is not sufficient for obtaining the Title of a *Just Man*, now and then to render to another his due; but it is of absolute necessity that he be in full and constant Resolution of doing the same whenever occasion shall offer.

II.
The Will
or Purpose
of a Just
Man, must
be perpetual.

There are 2 things wherein the whole requiring or duty of *Justice* is contained; the first whereof is to do *Good*, that is, to pay ones due; and the other to avoid *Evil*, that is, to hurt no body, and to decline all those things that may prove hurtful or incommodious to others. Not as if this latter part of *Justice* did consist in not doing any harm, but in a desire of the *Mind* to keep off evil from others, and to remove it as far as lies in our Power.

III.
Two things
are re-
quired to
the exer-
cise of
Justice.

Justice, universally considered, is divided into *General* or *Legal*, and *Special*. *General* is that which considers the *Good* that is common to many; and its business is to make good *Laws*, and observe them when they are made. So that its *Object* is not every *Good* that is common to many, but that which conduceth to the advantage of the whole *Commonwealth*. *Special Justice* is that which we have before defined to be a *Firm Will* of giving every one his due, or a *Vertue* inclining the mind always to render to every man his Right, and that according to *Equality*.

IV.
The Divi-
sion of
Justice into
Legal and
Special.

Special Justice is subdivided into *Commulative* and *Distributive*; whereof the former is conversant about *Compacts*, *Exchanges*, and *Contracts*; but the latter consists in distributing *Rewards* or *Punishments*, amongst those that are the *Members* of a *Civil Society*. The former of these considers things, and the latter *Persons*; the first belongs to all, the second only to *Princes* and *Magistrates*.

V.
Justice di-
vided into
Commuta-
tive and
Distribu-
tive.

They are also distinguisht by their *End*, because the end of *Distributive Justice* is to constitute an equality between Proportion and Proportion; so as that there may be the same Proportion between the things that are distributed, as there is

VI.
These two
sorts of
Justice are
distinguisht
from their
End.

A a a a

between

between the condition of the *Persons*, to whom the Distribution is made. As for Example, when after a *Victory* obtained, some *Rewards* are to be distributed according to the desert and condition of the *Persons*; here an exact regard must be had to the *merit* and *dignity* of each, so as that the *reward* which is given may be greater or less according to the *Dignity* or *Worthiness* of the *Person*. But in *Commutative Justice*, the equality only of the thing received and rendered is considered, so as that the return must be equal, according to *Arithmetical Proportion*, to that which hath been received, without any respect had either to *Merit* or *Person*.

The following *Vertues* are annexed to *Justice* as its Species, viz. *Religion*, *Piety*, *Observance*, *Friendship* and *Gratitude*.

VII.
What Religion is.

Religion is the Top and Principal of all *Vertues*, whereby we worship and honour *GOD* with the highest *Love* and *Veneration*. For this must be the chiefest affection of *Man* to adhere firmly to his *Author*, and to own him as the principle of all *Good*. For the first business of *Religion* is to discover *GOD*, as far as human Frailty will permit, and to persuade *Men* that he is, or doth exist. For the due worship and honour we pay to *GOD*, is derived from the knowledge we have of him; that is, that we are certain that the *World* was made by him, and *Rul'd* and *Govern'd* by his peculiar *Providence*. And in the next place, that nothing happens to us without his command or permission; so that all things are design'd for our *Good*, and whatsoever befalls us, must be believed to have a tendency to our *Salvation*. For seeing that his knowledge is most perfect, his *Power* infinite, and his *Will* most *Loving* and *Beneficent*, it is impossible that any thing should befall us, at his disposing, but must needs be for our *Good*. And tho' we cannot always perceive or understand this, yet we are to consider him as a *Physician*, who oft displeaseth his *Patient*, and puts him to *Pain*, that he may heal and make him sound.

VIII.
We must resign and submit our selves with all our concerns to GOD.

Relying upon this assurance we must submit all our concerns to him, and acknowledge that we are come into this *World*, not to prescribe *Laws* to others, but to follow those that are already established, and to yield a strict obedience to those which we are surely persuaded proceeded from him. Moreover we are in such a manner to order our *Prayers* we offer to him, as that we may obtain what is consonant and agreeable with this *Providence*, and to what he hath from Eternity decreed should come to pass. For he attempts, as it were, to corrupt the great *Judge* of all the *World*, who begs any thing of him, but what is the purpose of his *Will*. And above all things we are to remember, that we can never offer any more acceptable *Prayers* to him, or profitable to our selves, than those whereby we entreat him to moderate and subdue our *Affections*, and to captivate and overrule our *Will*, that we may always embrace what is best. We must also be assured and fully persuaded, that no *Sacrifices* are more pleasing to him, than such as proceed from a pure *Heart*, and which are accompanied with an *Innocent Life*. Let us therefore consecrate and dedicate our *Minds* to be his *Temple*, where we may offer *Sacrifices* to him, breath forth our pure *Affections*, and present to him the *Obiations* of our *Love*, *Worship*,

Veneration and *Subjection*. And after we have done all this, let us not be ashamed to make a frank and open profession, that we have done nothing worthy of his *Divine Majesty*, or that is worth his acceptance.

Having given to *GOD* the *Honour* due to him, we must proceed to the *Reverence* that is due to *Parents*, who are the *Channels*, whereby we have been conveyed into this *World*. And under this notion our *Native Country* first presents it self, which under a feigned name requires a true *Love* of us; forasmuch as of all *Societies* and *Fellowships*, as *CICERO* saith, none is more grateful and pleasing, than that which we have with the *Commonwealth* whereof we are *Members*. Our *Parents* are Dear, our *Children*, *Relations* and *familiar Friends* are Dear, but it is our *Country* alone that comprehends all these *Endearments*, for which no good *Man* would make any question to hazard his *Life*, to procure its *Weal* and *Happiness*. Indeed our *Country* contains all that is near or dear unto us, so that as long as that is safe, they are so too, but if that miscarry, all these are lost together with it.

Next to the *Love* we owe to our *Country* follows the observance and *Love* which is due to our *Parents*, who by special *Providence* have been destinated to bring us into the *World*, and who have been instead of *GOD*, by imparting *Life* to us. Who, if they be *Godly* and *Virtuous*, deserve a double *Honour* at our *Hands*, as promoting and leading us by their *Example*, *Exhortations* and *Precepts*, to *Vertue* and good *Manners*, and make it their utmost endeavour that we may be *Happy* in this *Life*. If they be *barsh* and *perverse*, yet we must always remember that still they are our *Parents*, and that we are beholden to them for our *Lives*. And accordingly by natural instinct we are led to relieve our *Parents* whensoever they are reduc'd to any *necessity*; and for the saving of them, not only to hazard the loss of all we have, but also of our very *Lives*. *Heathens* have done no less, who with the danger of their own *Lives*, and neglecting their *Riches*, have only made it their business and care to save their *Parents Lives*. Hence it was that *ÆNEAS* obtained the name of *Pious*, for having carried his *Father* safe out of the *Flames* of *Troy*, and through the midst of his *Enemies*, *Æneid* 5.

Him I through raging Flames did on my Shoulders bear,
Through Armed Troops, and Darts that clogd the Air.

Let us not disdain herein to imitate a *Heathen*, and to learn from those who by the sole instinct of *Humanity* exposed their own *Lives*, to save their *Parents*.

Observance is a Species of *Justice*, whereby we *Honour* and *Reverence* those that are our *Superiors* in *Age*, *Condition* or *Gifts*; for to all these *Honour* is due, as a reward of their *Labor* and *Dignity*: For seeing that they take care for the *publick Good*, and endeavour to promote the *Happiness* of their fellow *Citizens*, nothing can be rendered to them in lieu hereof but *Honour* and *Respect*; for should they demand any thing else, they would be so far from being honourable, that they

IX.
Piety or Love to our Country.

X.
Observance to Parents.

XI.
Observance towards Superiors.

they would appear to all, to be mean and covetous.

XII.
Friendship
between
Equals.

Forasmuch as *Friendship* is a kind of Equality, it must also belong to *Justice*, as being nothing else but a mutual *Benevolence*, by which some persons mutually desire to do good to each other. This is the best of those things that can be obtained in this *Life*, as being the ground and foundation of our *Happiness*. This is that which takes away all the bitterness of this *Life*, and exalts all the sweets and pleasures of it. In *Prosperity* it furnisheth us with an object for our *Benevolence*, in *Adversity* and *Misery* it affords us an object which we may relieve and comfort. *Friendship* teacheth us when we are young, comforts and cherisheth us when we are old, and being never forgetful of her Duty, doth at all times help and assist us. Wherefore it is only to be lookt for amongst good Men, and they only are to be beloved with this *Love* of *Friendship*, whom of a long time we have known to be honest Men, and are far more considerable for their *Vertues* than for their *Riches*: And accordingly we are to endeavour to gain such as these by all occasions, and to preserve their *Friendship* when gained by all good Offices.

XIII.
Gratitude
or Thank-
fulness.

Gratitude is a *Vertue* that preserves a pleasing and acceptable *Memory* of *Benefits* received. This part of *Justice* seems to comprehend all other *Vertues*, forasmuch as no Man can be Pious, Friendly or Observant, that doth not live in the exercise of *Gratitude*. For what else is *Piety*, according to *TULLY*, but a grateful *Affection* and inclination towards our Parents? Who are good Citizens, and deserve well of their Country both at home, and in the Wars abroad, but such as are mindful of the *Benefits* they have received from their Country? Who are Holy and Godly, but those who with a thankful Heart and Mind full of acknowledgement, give GOD the *Glory* of all his *Benefits*? What *Pleasure* can there be in this *Life* without *Friendship*? And what *Friendship* can there be betwixt ungrateful Men? Who amongst us, that hath been liberally educated, doth not with Joy and *Gratitude* entertain the *Memory* of those who have educated us, and been our Masters to instruct us in good *Literature* and *Manners*? Who is, or ever was so Rich, that his *Wealth* was equivalent to the *Love* and good Offices of many *Friends*? Which cannot subsist without *Gratitude*, and a thankful remembrance of *Benefits* received. Wherefore it is the Duty of every one to endeavour to carry himself thankful towards all, and never to forget any *Kindness* done to him, if ever he desire to please and satisfy himself or others.

XIV.
Charity.

There be also some other *Vertues*, that are contained within the compass of *Justice*, viz. *Charity*, *Humanity*, *Civility*, *Affability*, *Hospitality* and *Liberality*.

Charity is that *Vertue* which incites us to *Love* all Men, and to succour and relieve them according to our ability. For seeing that the *Happiness* of this *Life* consists in *Action*; we are not only to bear a good Will to our Neighbours, but must endeavour to assist and help them by our Works and Actions. For as the Sun is beneficial to all, and doth not pick and choose some only; to whom he may communicate his *Light*; so likewise must our *Love* be extended to all, and being dilated by this *Vertue* of *Charity*, embrace all, and do good to all.

Humanity is that *Vertue* whereby with a kind of *Benevolence*, we express and testify to all Men our readiness to serve and oblige them, from a due sense of the *Dignity* of Man, and our common Bond of *Consanguinity*.

XV.
Humanity.

Civility is a *Vertue*, whereby a Man from the Sense of common *Humanity*, doth speak courteously to all those that have any business with him, or that he meets with; and makes use of such Words and Gestures, as do express a kind of *Benevolence* and *Benevolence*.

XVI.
Civility.

Affability is that *Vertue*, whereby a Man in his discourse with others, as well by his readiness and easiness to hear, as by the sweetness and agreeableness of his Speech, doth gain the Hearts of those he hath to do with.

XVII.
Affability.

Hospitality is a *Vertue*, which makes us kind and obliging to Strangers, by giving them kind and free Entertainment; not only because they are Men, but because being Strangers and out of their own Land, they may want many things, which at home and in their own Country they plentifully enjoy.

XVIII.
Hospitality.

Liberality is a *Vertue*, which prompts us to be beneficial to others, freely and spontaneously according to our Abilities. This *Vertue* hath 2 extremes, for if our *Benevolence* be deficient, that is, less than it ought, we deserve the name of Covetous; but if we exceed in our Gifts and Kindnesses, so as to give more than we ought, to others than we ought, or at another season, or for other reasons than we ought, we fall into a Vice, and are justly called Prodigal. And accordingly, saith CICEERO, those Men are Prodigal who by Feastings, Doles and Shews, or by the vast charges of Plays and Publick Huntings, squander away their Money upon such things, the memory whereof is either none at all, or very short lived. But such are truly Liberal, who redeem Slaves, pay the Debts of their Friends or Poor Men, or assist them in the bestowing of their Sons or Daughters, or for the getting of an honest livelihood.

XIX.
Liberality.

CHAP. XIII.

Of the usefulness of the Passions or Affections of the Soul.

Forasmuch as the *Vertues* do arise from the Affections of the Soul, and that they are wholly conversant and taken up about the Ruling and managing of them, I should be wanting to the design of this Discourse, if I did not examine the usefulness of them, and shew how many several ways they may be advantageous to Men. It is very notorious with what Virulence the Stoicks inveigh against the Passions, who being too solicitous for the Tranquillity of their Wise Man, have supposed them to be altogether Evil, and therefore to be avoided by him, whom they will have to be exempt from all Vices, and not subject to any Perturbations. I confess my self formerly to have pleaded their Cause in my Discourse entitled, *L'Homme sans Passions*, and not only to have maintained SENECA'S Opinion, but also according to my slender Ability, endeavour'd to advance and exalt it. But forasmuch as I now follow the sentiments of DES CARTES, and

I.
The Opin-
ion of the
Stoicks.

my

my business is not to explain the *Opinions* of others but only to lay open *Truth*, no understanding, man will reproach me of *Lightness* or *Inconstancy*, for going about to unfold the usefulness of the *Passions*, and leaving the *Stoicks*, consider *Man*, not as Translated amongst the *Glorified Saints* in *Heaven*, but as placed amongst his *Mortal Brethren* here on *Earth*.

II.
Virtues
without the
Passions are
weak and
languishing

For the clearing of what I intend to deliver on this Point, it will be of use to call to mind that the *Passions of the Mind*, are certain Sensations or Perceptions of the *Soul*, which have a *special Relation* to the same, and are produc'd and maintained by the motion of the *Spirits*: As hath been declared more at large, in the foregoing part of this *Institution*. Now it is apparent, that these *Commotions of Mind* do greatly assist, corroborate and invigorate all *Human Functions*. For doth not daily experience teach us, that all *Human Actions* are dull and lifeless without them, and that the vigor of the *Mind*, where they are absent, ceaseth and fails? *Reason* it self in many cases appears dull and heavy, if it want the brisk company of *Affections*, and becomes stupid, when not excited with the *Spurrs* and *Goads* of the *Passions*? Where shall we meet with *Fortitude*, that undertakes the most hardy and difficult attempts? Which pursues *Dangers*? Which dares and provokes the most terrible *Evils*, except it be assisted by *Anger*, which excites it to revenge the injuries and affronts done to ones *Country*, *Parents* or *Friends*? *Prudence* peristeth, where *Fear* is wanting to put it upon making provision for the Future: For it is this Monitor puts *Prudence* in mind of what *Evils* may happen, how she may obviate them, and by what means repel them? Who ever attempted any thing that was Great or Generous, without a strong and exalted *desire*? What *Eminent Orator*, or *Famous Philosopher* ever conceived or brought forth, any thing that was Rare and Excellent without it? Why are so many toilsome and expenceful *Travels* undertaken, to visit unknown *Nations* and *Countries*, but from an ardent *desire* of *Seeing* and *Learning* things unknown? Who loves *Vertue*, that is not accompanied with *Joy* and *Gladness*? For bare and naked *Vertue* is neglected and despised, except it promise, and actually bestow pleasure and satisfaction upon its Followers.

III.
Two things
are requi-
red to make
the Affec-
tions good.

The *Affections* therefore are good, and contribute to the Perfection of *Human Life*, as long as they observe these 2 following *Rules*. First, that the *Object* they are conversant about be *lawful*: For *Affections* seem to have been bestowed upon us by the *Author of Nature*, that they might excite us to the pursuit of *Vertue*, and the declining of *Vice*. The *Second* is, that our *Passions* be proportioned to their *Objects*, and comport with the *Light of Reason* in all their motions. For such is the force and power of *Reason*, that it thoroughly searcheth into, and contemplates the nature of *Objects*, perceives the *Qualities* of each of them, and distinguisheth them from others: He who follows her, is safe and secure from Error, and forearmed against all deceptions whatsoever. So that he has his *Ears* open to the instructions of *Reason*, who loves the best Good with the Highest love and *Affection*, and all other things according to their several degrees of worth and merit.

The *Passions* therefore are very useful to the *Actions of Human Life*, as long as they are subject to the command of *Reason*, and attempt nothing contrary to its *Dictates*. For they are the Master of *Vertue*; and as *Fire* becomes extinct, when it wants *fuel*; so without the *Affections* *Vertue* remains idle, and unactive. For what great thing can it ever attempt, as long as it continues fixt in its own mean or middle Point, and is not spurred on by the *Passions*? As long as the timorous *Thoughts of Human Wit*, are not excited to some choice or other? As long as *Fortitude* is not stirr'd up to gallant *Actions*? As long as *Justice* is not Arm'd with her *Sword*? And lastly, as long as *Temperance* is not kept within its due bounds by *Fear*, *Shame* and the *Emulation* of our *Perfidious Nature*? How are all *Human Functions* over-whelm'd with a deep Sleep, where for want of the awakening motion of the *Passions*, *Men* are not rowzed from *Rest* and *Idleness*, to *Briskness* and *Activity*?

But you'll object that most of the *Passions* are *Evil*, and lead us headlong to *Vice*: For as they break forth suddenly upon the *Soul*, so they hurry her away without expecting the advice and counsel of *Reason*, and reduce her to the blind and wild condition of *Beasts*; like unruly *Horses* that will not be restrained, running headlong into the *Precipices* of unlawful *Lusts*, accursed *Envy* and *Hatred*, and mad *Superstitions*.

To which I answer, that what I have said concerning the usefulness of the *Passions*, must only be understood of them, inasmuch as they are subject to the command and guidance of *Reason*, and proportion'd to their *object* and *end*; which then only takes place when those things are *Loved* that ought to be *Loved*, and when such *Objects* are loved in a higher degree, which because of their greater worth deserve more of our *Love*. For *Love* and the rest of the *Affections*, are never *Evil*, as long as they keep within their Bounds, and pursue only those *Objects*, that are agreeable to *Reason*. But as there are some *Passions* that are of no use at all to *Men* except they be moderated, and reduced to *Mediocrity*, to the end they may be subservient to the acquisition of *Vertue*: So some of them are so very good of their own Nature, that the more they exceed the better they are; for inasmuch as they always follow the Guidance of *Reason*, they cannot but be upon all occasions, fruitful and advantageous.

For there is a twofold excess in the *Passions*, the one whereof changeth the nature of a thing, and of *Good* makes it become *Evil*, and by this means hinders it from continuing in subjection to *Reason*. So we find that some *Affections* do to that degree oppose the motions of *Reason*, and depress the force of the *Mind*, that being wholly abandon'd by it, they degenerate into down right *Vices*. The other excess is, whereby the degree or measure of the *Passion* only is encreased, and of a *Good* one is made *Better*. Thus *Boldness*, or as others rather express it, *Rashness*, is not said to be an excess of *Fortitude*, save only when it transgresseth the Bounds of *Reason*. But yet *Fortitude* is also capable of another kind of Excess, even whilst it continues within the said Bounds; which consists in this, that it is not subject to be shaken or moved by any *Doubt* or *Fear*: Which Excess is so

IV.
Passions are
useful to
the Actions
of Life.

V.
An Objec-
tion a-
gainst the
usefulness
of the Pas-
sions.

VI.
The Objec-
tion an-
swered.

VIII.
A twofold
excess is to
be consider-
ed of in
the Passi-
ons.

so far from being Blame-worthy or Reproachful, that the Tongues of all Orators are not sufficient to extol and commend it, this being the peculiar *Vertue* of *Heroes*, whom the *Antients* ranked amongst the *Gods*.

CHAP. XIV.

What is the use of Wonder or Admiration.

MOST of the *Antients* had but a mean Esteem for *Admiration*, as looking upon it to be the Vice of Ignorant Persons; and therefore took it to be an *Enemy* to *Human Felicity*, and the fruitful Mother of *Sorrow*, *Fear*, *Desire*, and other *Passions* that are the Tormentors of *Mankind*. And accordingly *HORACE* supposeth that *Men* would be exempt from all these, if once they could leave their wondring, *Lib. 1. Epist.*

Nothing t^e admire is th^e only thing that can Make and preserves a Blest and Happy Man.

But these *men* do not seem to have rightly understood the nature of *Admiration*, but rather to have confounded it with *Fear*, which beholds every thing with Trembling, and is affrighted at all the unusual *Objects* it meets with. But forasmuch as *Admiration* is nothing else but a suddain Occupation of the *Mind*, whereby it is strongly carried to the attentive consideration of those *Objects*, that appear rare and strange unto it, no body can deny but that it must needs be very conducive to the Learning and Remembring of those things we were ignorant of before. For it is evident, that there are chiefly 2 Principles which concur to the invention of every Art, viz. *Admiration*; because as soon as any new thing is suddainly presented to our Understanding, our *Mind* is presently struck with *Admiration*, and is powerfully rowzed to the searching into the Nature of it; and *Experience*, because the *Mind*, being allured by the *Admiration* of a Rare and Uncommon *Object*, never rests till it have found by Experiment, what the Nature of it is, and the Cause of it. So they who first observed the *Eclipse of the Sun*, being seized thereat with extraordinary wonder, it engaged them to search into the Cause of this unknown *Effect*, till after many repeated experiments, they found that the same was caused by the *Moons* moving between the *Sun* and the *Earth*; whence they gather'd this Proposition of certain and undoubted Truth, that a *Solar Eclipse* is produced by the interposition of the *Moon* betwixt the *Earth* and the *Sun*.

The necessity of *Admiration*, in order to the attaining of *Knowledge*, is very apparent from this one instance, that commonly those who are destitute, or not apt to be touch'd with this *Passion*, are commonly unlearned, and very ignorant. For, notwithstanding that many things present themselves to our Understanding, or offer themselves to our Senses, yet will they never be fixt in our Memory, except by some *Passion* they be impress'd in our Brain, or by the intent application of our Understanding, being determined by our Will to a serious Attention. For rare and unusual *Objects* encrease our Attention, because by their Novelty they leave a deeper impress of themselves; and

the *Spirits* flowing thither, do encrease the application of the *Mind*; by which means we frame more lively and lasting *Idea's* of things. Moreover, *Admiration* is of great use for our attaining of the knowledge of things which formerly we were ignorant of: For a *Man* that is seized with *Admiration*, compares the unknown *Object*, with things that he hath formerly known; by which means he sees it to be different, and enquires why it differs from them. Hence it is that *Admiration* is called the Beginning of *Philosophy*, the Seed of *Knowledge*, and *Abrupt Science*. To admire, saith *PLATO*, is much the Affection of a *Philosopher*; neither indeed can any other Original or Beginning of *Philosophy* be assigned but this.

The esteem of ones self, which is a Species of *Admiration*, is conducive to every man, in as much as it shews him, that he hath something that is his own, and possesseth some *Perfections*, in consideration whereof he may respect and love himself more intimately than all other things. For *Self-Love* is a Lawful Affection, it being allowed to every man to consider himself before others. Moreover, a man by loving himself, imitates *G O D*, who, like a Circle, turns into, and terminates in himself, and loves himself with the Highest and Essential Love. This is the Property of *Wise Men*, who, subduing all foreign things to their Mind, do so highly esteem the dignity thereof, that they account it the highest Sacrilege to defile it with filthy and vain thoughts. Hence it is that they have an awful regard for themselves as for *Deities*; and abhor to commit any thing that might make their Consciences to condemn them. And to this purpose *ARISTOTLE* in the Second Book of his *Politicks*, proves that a due Esteem of our selves is a *Vertuous Quality*; and if at any time *Self-Love* is blamed, that is only so far as it exceeds its Bounds, and makes us to love our selves over-much.

On the other hand, the Contempt or Low esteem of ones self, by which a man despiseth his own worth and merit, is very conducive to *Humility*, and makes him refuse the Honour others render to him. This *Vertue* teacheth him, that the praises of others are useful to him, as long as he continues vile in his own Eyes; and that he is not to mind what others say of him, as long as he is conscious to his own defects and meanness, and that he wants those very *Vertues* which others extol him for. This *Passion*, moreover, hath this good effect, that it makes us to despise no man; but owning our selves to be men, prompts us to measure their Vices with the same Equity wherewith we censure our own. For it is but Reasonable and Equitable, that knowing our own weakness, we should take pity on others, and according to the command of *Charity*, think better of them than of our selves: For indeed what do we know, but they may far exceed us in *Vertue*? and tho' they have fallen as *Sinners*, yet may have risen again as *Saints*. We may lawfully condemn our selves, but cannot despise any other without *Sin*, and being injurious to our Neighbour.

VENERATION, whereby the Soul is engaged to esteem the *Object* it respects and honours, and to subject it self to the same, teacheth us to Reverence those Powers that are above us, and to render unto them the Honour that is their due.

B b b b b

I. Some condemn Admiration.

II. Wonder or Admiration is necessary for the acquiring of Sciences

III. Those who are not apt to Wonder, are generally unlearned.

IV. The Esteem and due Value of ones self, how it may be profitable.

V. The undervaluing of ones self is a great help to Humility.

VI. Veneration teacheth us, to respect every one according to his Merit.

due. For seeing that *Authority* is various, and that the *Persons* that are above us, are not all of them of equal *Dignity*, *Veneration* prompts us to honour every one of them, according to the different *Power* and *Order* they have in the *World*, rendering them a various *Respect* and *Worship*, according to the difference of their *Merit* and *Dignity*.

VII.
Our Parents.

In the first place therefore, it puts us in mind of the *Reverence* we owe to our *Parents*, as to *G O D's Vicegerents*, who have brought us forth into the *World*, who with anxious and solicitous care have educated us, who have instructed us in the *Duties of Religion*, framed us to *Vertue*, and furnished us with *Knowledge* and *Learning*. For since it is most agreeable to *Nature*, to *Love* those who *Love* us; how great is that *Love* which we owe to our *Parents*, seeing that our *Love*, be it never so intense, will not equal their most tender *Care* and good *Will* towards us?

VIII.
Magistrates.

In the next place, it adviseth us to honour *Magistrates*, and such as are in publick places of *Trust* and *Authority*. For seeing that they watch for the *Weal* and *Welfare* of the *Commonwealth*, and are set over the *People*, to the end they may assist and help them, procure their safety, and secure their *Estates*, they certainly deserve *Honour* and *Respect* from all whose happiness and welfare they contribute to.

IX.
Wise men.

This *Affection* also teacheth us to *Honour* and esteem those that excel in *Wisdom* and *Vertue*, and do recommend them, by the *Examples* to all others.

X.
Disdain.

Neither is the *Passion* of *Disdain* altogether useless, whereby the *mind* of *man* contemns some persons, and accounts them so much below it self, as to know that it is not in their *Power* to do him either *Good* or *Evil*. For this *Passion* is not a little conducive to the *Quiet* of the *Mind*, by raising it above the reach of any *Mortal Power*, making it to be unconcerned at their *Promises*, and fearless of their *Threats*. Especially in cases where the Cause of *Vertue* is to be appear'd for, or *Vertue* to be maintain'd.

CHAP. XV.

Of the End or Usefulness of Love and Hatred, and the Interpretation of them.

I.
Love teaches us to do good to others.

IT is an in-born instinct of the *Will* of *Man*, to desire that which is *Good*, and to testify its displeasure, when it cannot attain it. Thus we see that a *Covetous Man* desires *Riches*, and an *Ambitious Person* pursues *Honours*, because they look upon these things as *Good* for themselves, and are with earnest desire carried towards them, as to things perfective of their *Nature*. For *Love* is nothing else but a *Thought* or *Cogitation* of the *Mind*, by which it is stirred up to join it self in *Will* to those *Objects* which appear agreeable to it. So that this *Passion* puts us in mind to do good, not only to our selves, but to others also: Forasmuch as all men are united to us by a likeness of *Nature*, and constitute but one *Politick Body* or *Society*; wherefore also we are drawn by a natural impulse to bestow *Benefits* upon them, and to procure their profit and advantage, as far as lies in our way. For *Love* is a *Beneficent Passion*, and

rejoyceth to diffuse it self, to a vast variety of *Objects*. Hence it is that *PLATO* feigns it to be the *medium* between that which is Deformed or Ugly, and that which is *Beautiful* and *Lovely*; between that which is *Mortal* and that which is *Immortal*, because it cherisheth and maintains *Human Society*; and joyning contraries together, links the *Proud* with the *Humble*, and the *Poor* with the *Rich*. We shall therefore make a good use of this *Passion*, by assisting and relieving our *Neighbours*, and by desiring and promoting the good and welfare, not only of our selves, but of others also.

II.
And to hurt no Body.

But forasmuch as some, under pretext of helping their *Neighbours*, do injure them: The Interpretation of this *Affection* is, that in doing good we take care that we be not hurtful or prejudicial to any: but that we assist them willingly and heartily, and endeavour to promote their good from a pure instinct of *Charity*, and be to them as *Light* which penetrates all *Diaphanous Bodies*, without any hurt or prejudice, either to them or it self.

III.
Devotion excites us to love GOD.

By *Devotion*, which is a *Species* of *Love*, whereby the *Lover* esteems the Beloved *Object* more than himself, we are taught to love *G O D*, and embrace him with the utmost extent and strength of our *Affections*. To which *Divine Love* we may arrive, by considering that *G O D* is a *Spirit*, or a *Thinking Being*, upon which account, seeing that our *Soul* is of affinity with his *Nature*, we are persuaded to believe, that it is an Emanation from his *Supream Intelligence*, and, as it were, a *Particle of the Divine Breath*. Moreover considering the *Immense Power* whereby he created the *World*, and all the things that are, without any preexistent matter; the infinite reach and extent of his *Providence*, which, with one view, beholds whatsoever is, was, or is to come, yea, or can be: the unerring certainty of his *Decrees*, which tho' they be absolutely unchangeable, yet do not in the least prejudice the liberty of *Man's Will*. And lastly, by making a deep reflection upon our own great weakness, and on the other hand, on the *Amplitude of the Universe*, and all *Created Beings*, how at first they proceeded from *G O D*, and do still so depend on his *Power*, that they cannot subsist a moment without his *Care* and *Providence*. For the due consideration of all these things, will kindle a desire in us to be joyned to him in *Will*, make us to venerate his *Decrees*, as judging them most necessary and equal, and to wish for nothing more than to obey his *Will*, and for his *Glory* make no difficulty to hazard the loss of all things, even of our *Lives*, and in a word, to undertake or suffer any thing that may be offered to us.

Complacency is another *Species* of *Love*, whereby the *Soul* is carried out in desire towards *Beautiful Objects*, being greatly taken, and charmed with their aspect. For *Beauty* hath something whereby it powerfully recommends it self, so as to allure the *Eyes of Spectators*, and force an admittance into their *Hearts*. Hence the *Antients* were pleased to call it a *silent Imposture*, and a *Dominion* which needs neither *Arms* nor *Guards*, such as persuades without words, and makes all men readily to submit to its *Imperious Yoke*. This *Passion* prompts us to desire the *Beauty of Worldly things*,

IV.
Complacency is a help to the Love of Vertue.

things, and wholly to betake our selves to the Love of *Vertue*, and by trampling upon all *Earthly Enjoyments*, to aspire after *Cælestial Objects*. For if a comly shape of the *Body*, if a sweet and beautiful Aspect, if the sparkling lustre of a brisk and lively *Eye* be of force enough to astonish, ravish and surprize, what a degree of *Love*, think we, will not *Vertue* be able to enkindle in the Hearts of its Contemplators, who, if we will believe *SENECA*, sends her *Light*, as a *Harbinger* before her, into the Hearts of all *Men*, so as that even those who do not follow her, are convinced of her *Beauty*? What can be compared to the *Life* and *Vigor* which *Fortitude* communicates to the *Eyes*, to the *Intention* they derive from *Prudence*? to the *Reverence* wherewith *Modesty* adorns them? to the *Brickness* and *Serenity* which *Joy* affords them? and lastly to the *Awfulness* which *Severity* puts upon them? What can be imagined more *Beautiful* than *Justice*, which makes *Princes* most like to *GOD*? What more comly than *Temperance*, which sets bounds to *Pleasures*, and never embraceth them for their own sake? What more sweet and lovely than *Humility*, which is affable and courteous to all, and doth so far only desire its own *Good*, as the same may be serviceable and profitable to others? What more grateful and pleading than *Clemency*, which spares the *Blood* of another as its own, which by its kindness turns and overcomes the minds of the *wicked*, and sweetly comforts the *afflicted* and *miserable*? So that by beholding of *Beautiful Objects*, we are insensibly led to the love of *Vertue*, and taught to despise and neglect these frail and changeable *Beauties*, and to pursue the *Eternal Excellence* and *Comeliness* of *Vertue* and *Goodness*.

V. Hatred makes us to abhor Vice.

Neither is the *Passion* of *Hatred* altogether useless, where it meets with *Objects*, on which it may justly discharge its *fury*. For we hate all those things that hurt us, or injure our *Soul* or *Body*; and therefore we have good reason to abhor our *Vices*, and to avoid all those things that disturb our *Peace* and *Tranquillity*. For if it be natural to the *Soul* to separate it self by *hatred* from the things that are hurtful to it, what *Evil* ought the more to detest, than that which, in a manner, destroys and annihilates it? For the *Soul* dies whilst it commits *Sin*, and lays violent hands upon it self, as oft as it transgresseth the *Commands* of *GOD*, and thwarts the *Dictates* of its *Conscience*. Wherefore it is but justice to hate our selves upon the account of *Sin*, and to be inflam'd with an holy *Anger* against our *Defects* and *Transgressions*, forasmuch as by means thereof we are turned aside from our *Chiefest Good*, and depart from him, with whom to be united by *Love* is the *Sovereign Bliss* of *Man*.

VI. Horror or Abhorrence makes us to avoid Bad Company.

The *Horror* we are seiz'd with at the beholding of ugly and deformed *Objects*, teacheth us to avoid all manner of *Wickedness* and *Pravity*, and to eschew the company and familiarity of those, who are likely to infect us with their corrupt manners. For seeing there is nothing in Nature more ugly and deformed than a *wicked and perverse Man*, we have all the reason in the *World* to avoid such a one, as we would do the *Plague*, lest we should be corrupted by his familiarity, and his *Vices* insensibly should get ground

of us. *Drunken Companions* easily draw in their Associates to the same *Excess*; and *Lustful* and *Unclean Persons* infect those they converse with, and effeminate the *Minds* of those that keep them company. *Corvetous Persons* inspire their familiar Friends with a *Stingy Humour*. But what *Body* can be so deformed and monstrous, what *Skin* so scabby and ulcerous, as to compare with the ugliness and filthiness of *Vice*, which changes *Men* into *Beasts*? This *Passion* therefore will be of great good use to us, if it prompt us to detest the depraved manner of *wicked men*, or whatsoever can defile or weaken our *Innocence*.

CHAP. XVI.

Of what use the Passion of Desire is.

THE End and use of *Desire* is manifest from its *Definition*, which declares it to be a *Passion*, whereby the *Soul* is carried towards a *Good*, considered as *Future*. Which words sufficiently shew that this *Passion* aspires after those things which it wants, and wishes the conversation of those which it enjoys. The *Soul* by *Desire*, is carried to the Possession or enjoyment of some *Good*, like an *Arrow* driven from a *Bow*, and being raised upon the wings thereof, flies to the Mark.

Accordingly the *Soul* by *Hope*, which is the first Species of *Desire*, is stirred up to desire *Happiness*, and to enjoy that *Good*, which alone can satiate it. For as *Bodies*, by motion, approach nearer to their *Centers*; so the *Soul*, through *Hope*, tends to *Happiness*, and by its earnest wishes and desires, hastens that, which it so much longs for. Wherefore it looks upon these days, during which it is compelled to live here amongst *Mortals*, as already past and gone; and neglecting things present, esteems them as past, before ever they are come. And by this means it is neither corrupted by the *Prosperity* of this *World*, nor cast down by *Adversity*; applying the whole drift of her intent to this only, that none of these things may be a hinderance to her in her Progress to *Bliss* and *Felicity*. O Thrice Happy and Blissful *Hope*! whose *Promises* are so great and glorious, that they make a *Man* Happy and Blessed, even before he is in full possession of it.

On the contrary, *Fear* adviseth us to undertake nothing without *Heedfulness* and *Circumspection*, and to avoid *Rashness* in all our *Actions*. In the first place it teacheth us to examin all those things that may any way hinder or stop our intent, and to deliberate maturely and at leisure, about all those matters that are liable to change. For *Precipitancy* is without foresight, and cannot but frequently have *Repentance* for its Companion. And in the next place, that we foresee things to come, and with great exactness and diligence, consider the *Evils* that may possibly happen to us: For foreseen evils are less afflictive, and we bear those things much more easily, that have been our constant expectation. *Fear* therefore warns us, that standing in our *Watch-Tower*, we should keep a watchful *Eye* upon things to come; and as far as *Human Foresight* permits, anticipate the mutability of *Fortune*, the endeavours of our *Enemies*, and the insultings of *Men* in *Power*. For Afflictions

I. Desire teaches after the things it wants.

II. Hope enticeth the Soul to desire Beauty.

III. Fear teacheth Circumspection and Caution.

IV.
The Usefulness
of
Jealousie.

Afflictions and *Hardships* are only intollerable to him, whom they seize all on a suddain and at unawares, and whom they strike before they are discern'd.

Jealousie will stand us in good stead, when by it we are stirr'd up to endeavour to secure the Possession of those things which we count the best and most excellent of all others. This *Passion* moves and actuates the *Philosophers*, when they contend for the *Truth*, which they suppose themselves to have espoused, as for their nearest and dearest Interest, and endeavour to vindicate it from all Suspicion of *Erreur*, in opposition to all the Attacks and Assaults of their *Adversaries*. Hence it is that Controversies about *Religion* are maintained in the *Minds* of *People*, whilst every one is *jealous*, lest the *Religion* he professeth should suffer any thing by his slackness or indifference, or that he should be forced to desert it. Thus *Princes* and others, that have an *Honourable Name* in the *World*, are extremely *Jealous* of their *Good Name* and *Reputation*, and leave no *Stone* unturn'd to preserve the same in its full Luster and Glory; because they look upon the Opinion which others have of their *Vertue*, to be above all things most conducive to their *Honour* and *Esteem*, as well as the safest and strongest guard, against the Assaults of their *Enemies*. In a word, *Jealousie* may be of use to all, if the *Good*, the loss whereof they apprehend, be of great Concern to them, and such as they cannot be deprived of without great Shame or Loss. For as no Body faintly and carelessly Endeavours the obtaining of *Riches* or *Honour*; so it is no wonder to see *Men* strangely moved and concern'd, whenever they are threatned with the loss of either of them.

V.
Despair is
sometimes
of use to
Lovers.

Altho' *Despair* be the most odious of all *Passions*, and be generally accounted the Common *Enemy* of *Mankind*, yet is it not altogether without its Usefulness. For inasmuch as it considers the desired *Object* as Impossible, and excludes all hope of ever obtaining it, it may be of advantage to *Lovers*, when they find themselves neglected and despised by the beloved *Object*; because then this *Passion* strongly persuades them to give over their vain pursuit, and to cease their fruitless Endeavours, and to quit themselves of their Ill-advised *Desires*. It tells *Men*, that it is *Madness* to doat upon an ungrateful and insensible *Object*, and to cast away our *Love* upon that which cannot, or will not love us again.

VI.
Despair
makes
Soldiers
Valiant.

As *Despair* proves advantageous to *Lovers*, so likewise it is useful to *Souldiers*, in cases where they are prest with *Difficulties*, and see no way open to escape their *Enemies*: For then it prompts them, since they are necessitated to engage those that are much stronger than themselves; and that in all probability they must dye, to sell their *Lives* as dear as they can, and in some kind make amends for their Loss, by causing a greater Loss to their *Enemies*. For *Necessity* often steels *Cowards* with *Valour*; and *Despair* hath often made weak and fearful *Troops* to triumph over *Conquerours*. This *Passion* inspir'd LEONIDAS, when with a small Handful of *Souldiers*, he set upon *Xerxes*, whose *Fleet* the *Sea*, and whose *Army* the *Land* was scarcely able to contain. For having posted himself with 300 *Men* in the Narrow-passage of the *Thermopylae*,

he stood the shock of that prodigious *Power*, and died valiantly with his whole little *Army*.

Fluctuation of *Mind* is necessary, when we are engaged in the Election of *Good things*; for seeing that one *Good* is preferable before another, and that all are not of the same Value, we have need of time before we can certainly know, whether the *Judgment* we frame concerning *Things*, be conformable to them, and consonant to all the *Circumstances* that concur to their *Perfection*. For we cannot, like *Angels*, understand things that are offer'd to us, in an Instant; our *Knowledge* is successive, and as the *Sun* from the Dawning increaseth to the perfect *Day*, so some time is to be allowed to our *Soul*, that after a mature Reflexion of *Judgment*, she may deliberate of things, and consider what she ought to determine concerning them. For seeing that things are various and manifold, and not equal in degrees of *Goodness*, their Nature must be diligently examin'd by us, that we may come to know what is *Good*, what *Better*, and what *Best* of all. For *Men* are very apt to favour their first *Thoughts*, and either from an Affection for *Novelty*, or too great Indulgence and Love for the Off-spring of their own *Brain*, to embrace that which first presents itself to their *Minds*. Wherefore *Delay*, which *Fluctuation* of *Mind* doth suppose, is very necessary to discern *Truth* from *Falshood*, and to make a due distinction betwixt *Good* and *Better*.

Courage and *Boldness* are good Helps to *Fortitude*, and superadd both Force and a Spur to that most *Generous Vertue*. For *Fortitude*, without the Company of *Boldness*, is but faint and languishing, and stands in need to be excited by its *Heat*, to the attempting and undertaking of *Great* and *Worthy Achievements*. This *Passion* may lawfully and worthily be employed, in repelling the *Enemies* of our *Country*, and in defending the *Life* and *Honour* of our *Prince*. *Nature* teacheth us to venture the loss of our *Hand*, for the saving of our *Head*; and to expose any part of our *Body*, to save the whole. This is that which *Boldness* performs, and when *Necessity* requires, does not only meet *Dangers*, but provokes and contemns them.

Emulation spurs us on to imitate the glorious *Actions* of *Famous Men*, by studying and eying the *Examples* of such as do exceed us in *Vertue* and *Learning*. It sets before our *Eyes* their *Achievements*, as so many *Originals* for us to express, and to take Copy by, suitable to the Requirings both of *Reason* and *Nature*. For there is an inborn Inclination in all *Men*, to become like their *Superiours* and *Betters*. This makes us to be always in the pursuit of those *Vertues* and *Perfections*, which we see shining so illustrious in others, and enflames us with *desire* to imitate the *Manners* and good *Qualities* of those who excel us, especially in *Intellectual Endowments*.

VII.
Fluctuation,
or,
Doubtfulness
of
Mind, use-
ful in the
Choice of
things.

VIII.
Courage
and Bold-
ness are
great Helps
to Forti-
tude.

IX.
Emulation
is con-
ducive to
Vertue.

CHAP. XVII.

Of the Usefulness of Joy and Sorrow.

I.
All pursue
Pleasure.

It is not without Reason that some Physicians tell us, That the desire of *Pleasure* is Natural to man; for it is subservient to the *Mind*, and fills and satiates the wants of the *Body*. Young men are inclined to *Pleasure* and *Oblectation*, because it is serviceable to the ready and vigorous performance of all *Bodily Functions* and *Exercises*, and conduceth to the increase and good state of it. *Melancholy Persons* addict themselves to *Pleasure*, because otherwise the *Humour* that predominates in them would consume their *Body*, and by its malignity make all the *Humours* thereof eager and corrosive. Old men delight in *Merriment*; for seeing that the digestive Faculty of their *Stomach* is slow and weak, and that the *Blood* and other *Humours* move but slowly through their *Bodies*, they are with great eagerness push'd forwards to *Pleasure*, as to the only Remedy against all these *Distempers*.

II.
Joy is
grateful to
the Mind.

What *Pleasure* is to the *Body*, that *Joy* or *Gladness* is to the *Mind*; for it always is a Consequent of its *Tranquillity*, and doth in a manner perfect and compleat all its *Operations*. For even as by a Natural Instinct we are carried to that which is *Good*, and have an Aversion for that which is *Evil*; so we pursue *Joy* and *Pleasure* under the Notion of its being *Good*, and hate *Sorrow*, because it appears to us to be *Evil*. But because *Joy* may be infected by its *Objects*, and be conversant about those things which are unworthy of our *Esteem* or *Regard*, we must examin what is the right use of it, and to what *Matters* it may lawfully be applied.

III.
Joy always
doth ac-
company
good Affi-
ons.

And indeed *Joy* and *Gladness* are not to be found, but in the Exercise of *Vertue*, and in the pursuit of *Honesty*; seeing that all other *Good things*, which we do so solicitously look after, do not bring forth any true *Joy*, but only some false and feigned *Chearfulness* and *Mirth*, which is always accompanied with *Anxiety* or *Repentance*. For there can be no true *Joy*, but that which springs from the Consciousness of *Vertue* and *Goodness*.

IV.
Derision is
useful for
the Reproof
of Faults.

Derision, which consists of *Joy* and *Hatred*, and is occasion'd by the deprehending of some slight or *Venial fault* or *defect*, is frequently of good use for the amendment of *Faults* and lesser *Immoralities*, making him who is derided, to be more watchful over his *Actions*. For finding his *Immoralities*, or undecent *Manners*, to be expos'd to *Jest* and *Laughter*, and that they furnish others with Matter of *Raillery* and *Merriment* at his Cost, he resolves to correct the same for the future, and so to prevent the like *Errours*, that he may no more become a *Laughing-stock* to others.

V.
Envy is
troubled
at the
Exaltation
of the
Wicked
and Un-
worthy.

Envy, forasmuch as it is a *Passion* and a Species of *Sorrow*, is not without its usefulness, it being that *Affection* whereby a man is displeased at the Prosperity or Elevation of another, because he is unworthy of it. For it seems but reasonable, to be moved with *Envy* and *Indignation* against those, who without their *Merit* are raised to ample *Fortunes* and high *Employs*. For whatsoever is conferr'd upon *Unworthy persons*, is look'd upon as a piece of *Injustice*, when that which should be the Reward of *Vertue*, is made an Encouragement

to *Vice* and *Wickedness*. From all which it is apparent, that this *Affection* is distinct from that *Envy* which is a *Vice*, because this latter hath not for its Object a Person *unworthy* of the *Good* he enjoys, but rather conceives a *Joy* and *Gladness* from the *Miseries* of the *Good* and *Vertuous*; whereas the former is only offended at the Prosperity of such as are *Unworthy*, but reaps no pleasure at all from the *Misfortunes* of those that are *Good* and *Vertuous*. The *Good things* for which we commonly *Envy* others, are *Riches*, *Honours*, and other such like, depending on the Gift of *Fortune*: For no Body is *Envied* for his *Vertue*, nor for his *Nobility*, *Beauty*, or other Endowments or Embellishments, whether of *Body* or *Mind*; forasmuch as they do not depend of his Industry, but were bestowed upon him by *Heaven*, before ever he was capable of committing any *Evil*.

Compassion, or *Pity*, on the contrary, provokes us to assist and relieve such as are in *Misery*, and to shew Kindness to those whom we suppose to be Unhappy, without any of their desert or merit. For it is not a *Vice* of the *Soul* (as some Philosophers have supposed) to pity the *Miseries* of others; but rather a kind of Pious *Sorrow* and Blessed *Misery*: Because this *Affection* doth not only move the *Mind* conformably to anothers *Calamity*, but also strongly excites it, to endeavour the easing and removing of it. For it is a *Duty* we owe to *Nature* and *Humanity*, to condole with those that are Afflicted, and to endeavour to lend a Helping-hand to those that are oppress'd with *Calamities*, and who without *Speaking*, strongly cry to us for help. It is no *Relief* to a miserable Wretch, that we are touch'd with *Grief* and *Compassion* at the sight of his Affliction, except also we do help and assist him to the utmost of our Power.

VI.
Compassion
relieves
such as are
in Misery.

Satisfaction, or *Content* and *Acquiescence* in ones self, doth greatly conduce to *Security* and *Peace* of *Conscience*, when we call to mind any good *Action* that hath been performed by us. For as, according to HOMERS Fiction, the Herb *Nepenthe* added to their Cups, banisht all *Sorrow* and *Sadness* from the Banquet of the Gods; so a *Good Mind* secur'd and guarded by the Rectitude and Uprightness of its *Conscience*, extirpates all solicitous *Anxiety*, and begets the highest *Joy* and *Pleasure*. For the *Soul* that is always accompanied by *Innocence*, seems, as it were, to applaud it self, and to be rais'd above this *Earth*, being Conscious to its self of no Crimes, nor distracted by the *Guilt* of *Sin*. Hence it is, that those who are safe and secure by reason of the Purity of their *Conscience*, are always of an even Temper, and tho' in the presence of a *Tormentor*, that stands ready to Torture them; of *Fire*, that is ready to consume them; and of a *Funeral Pomp*, to appall and terrifie them, continue unmoveable, fixed on the Rock of a good *Conscience*, being unconcerned at the raging *Waves* and *Winds* that roar about them.

VII.
Satisfac-
tion, or
Content,
produces
Peace of
Conscience.

But *Repentance*, which supposeth *Guilt*, and which torments the *Guilty* with the Checks and Stings of *Conscience*, puts them upon bewailing of what is past, and to get rid of the Burthen that presseth them. For as nothing is more pleasant and joyful, than a good *Conscience*; so nothing is more tormenting than a Bad one: No *Wild Beast*

VIII.
Repentance
is necessary
for the
Effacing
of Sin.

C c c c c

tears

tears and rends more Cruelly, no *Flame* burns more smartly, or *Torments* the *Body* more excessively, than a *Guilty Conscience* racks and tears the *Soul*, whose *Inmate* it is. Whosoever *Sins*, hath his *Punishment* immediately attending him, and his *Crimes* make him sufficiently miserable, without the Ceremony of a publick *Condemnation*. *Punishment* is the individual Companion of *Wickedness*, and never to this day was there any *Man* found that sin'd on free cost. *Repentance* therefore makes a *Man* after the *Commission* of *Sin* to hate himself, and from a serious abhorrence of his *Crimes*, to amend what is amiss, and enter upon a new course of *Life*.

IX.
Favour
makes us
so Love
the follow-
ers of Ver-
tue.

Favour, which makes us wish well to those that are *Vertuous* and do *worthy Actions*, is a great incentive to the *Love* of *Vertue*, because it inclines us to *Love* the same in others, and to bear good will to all the followers of it: Whereas on the contrary we do hate *perverse Men*; and tho' we do not abhor their persons, yet we do always abhor their *Vices*. It is inborn, and natural almost to all *Men*, to be angry with, and have indignation against *Evil doers*, and those who tho' they be never so criminal do go unpunished. But yet we are to take heed, that we do not imitate those *Peevish* and *Morose persons*, who are moved at things of little or no moment, and confounding slight fooleries, with the highest *Crimes* do abhor, the one as much as the other. It is the property of a *Morose* temper, to inveigh bitterly against small *Faults*, and to condemn all things that are not suited to his Temper and Apprehension.

X.
Gratitude
prompts us
to the re-
warding of
Benefits.

Gratitude, which preserves the pleasing memory of *Benefits* received, incites us to the endeavour of repaying them with like good *Offices*: Which may be done by us 2 manner of ways; the first when by *Gifts*, or otherwise, we acknowledge the *Favour* or *Benefit* we have received. Thus we read, that *AUGUSTUS CÆSAR* rewarded the good *Office* done to him by a *Veteran Soldier*, in rescuing him from imminent danger, at the *Battle* of *Actium*. For when he being accused at *Law*, and in danger of being condemned had desired *AUGUSTUS* to appear for him, *CÆSAR* would not suffer his *Attorney* to plead for him, but himself appeared, and pleaded, that he might not seem ungrateful to him, who had saved his *Life*. The other way of shewing our selves *Thankful* is, when we receive a *Benefit* with a grateful *Mind*, and are ready at all times to acknowledge it. For indeed the returning of a good deed, does not so much consist in our recompensing it by good *Offices*, as in a grateful temper of *Mind*, whereby we are ready to acknowledge the favour bestowed upon us. For a *Debt* may soon be paid, and what hath been *Stolen* restored; but he properly repays a *Benefit*, who keeps it always in grateful *Memory*, and owns himself under *Obligation* for it.

XI.
Anger is
of use to
Princes and
Magistrates

Anger, which the *Stoicks* do so much inveigh against, calling it a *short Fury* or *Madness*, hath also its use, as long as it continues within the Bounds of *Reason*, and does only moderately move and affect the *Soul*; for being thus qualified, it is serviceable to *Kings* and *Judges*, to the removing of *Lenity* and *Fear*, which may oppose themselves to the Strictness and Severity of the *Law*, and incline them to over much *Clemency*. Thus it is lawful for *Judges* to be exasperated

against the *Crimes* of *Malefactors*, who violate the *Laws*, and infect others by their wicked *Examples*. It is also serviceable to *Kings* in *Governing* of the *Commonwealth*; for it is necessary for *Kings*, to avenge the *Injuries* and *Indignities* offer'd to themselves, and to be as ready to punish *Traitors*, as to resist and oppose their *Enemies*. For who will say, but that it is a just anger in *Princes*, which engageth them to inflict the worst of *Punishments* upon *Traitors*, who are guilty of the worst of *Crimes*?

Glory and *Shame* are of extraordinary use, and advantage to those who are taken with the desire of *Vertue*; for these 2 *Passions* naturally lead to her, and tho' they go different ways, yet tend to the same end. For *Glory* is as it were a *Spur*, egging us on to great and generous *Actions*, and to the undertaking of the most hazardous *Exploits*. It was under the conduct and command of this *Affection*, that the *Romans* procured their *Greatness*, and subdued all their *Neighbouring Nations*. It cannot be denied but that the *Love* of their *Country*, was a great and strong motive in the accomplishing of those brave *Actions*, but yet their desire of *Glory*, was a much stronger incentive to them. For indeed *Vertues Vigor* and *Force* seems to languish and expire, when it is not kindled with the desire of *Praise* and *Honour*; and the whole strength and *Briskness* of the *Soul* is very rarely exerted, but in the midst of *Spectators*, that are ready to applaud and extol it.

And *Shame* on the other hand deterrs a *Man* from *Vice*, and makes those things odious, which otherwise would appear delightful. This *Passion* may well be called the *Guardian* of *Vertue*, because it makes us to flee from the Face of every shameful and filthy Act. This keeps *Judges* to their *Duty*, and compells them to do *Justice*, for fear of making themselves infamous. This *Passion* furnisheth *Women* with *Arms*, wherewith to defend themselves against the attempts of *Lewd* and *Lustful Men*. And therefore *SYNESIUS* calls *Shamefulness* the second *Good* of *Man*, because it keeps them innocent, and doth not only hinder them from committing *Wickedness* in publick, but also in private.

Chearfulness teacheth us to bear *Afflictions* and *Adversity* with a pleasant *Mind*, and to undervalue and despise the *Calamities* we lye under. It informs us that it is *Prudence*, to despise the *Evils* and *Calamities* of this *World*, and to rejoyce in the midst of those troubles, wherewith we are continually tost in this *Life*. For as *Gold* shines bright in the *Fire*, and by all the violence thereof loseth nothing of its weight or *Splendor*, so a *Chearful Mind* is of proof against the *Injuries* of *Fortune*, and turns its *Calamities* and *Afflictions* into *Pleasure*: It considers that nothing is more sweet, than the remembrance of past *Labours* and *Miseries*, and that that prosperity is sweetest, for which we have been prepared by the *Bitterness* of *Suffering*.

XII.
Glory and
Shame of
what use
they are,
and to
whom.

XIII.
Shame keeps
a man from
the Commis-
sion of Sin.

XIV.
Chearful-
ness assists
us in the
bearing of
Adversity.

CHAP. XVIII.

Of the Government of the Passions, and of their more general Remedies.

I. The particular Remedies of all the Passions are not to be here expressed.

Forasmuch as the Happiness of Man's Life, depends on the right governing of the Passions, and that they may be accounted truly happy in this World, that have attained to a full Dominion over them; we are to consider, how their Excesses may be best avoided, and the ill use of them prevented. Not that I do intend here to prosecute the particular Remedies of all the Passions, which Reason prescribes for the subduing or moderating of them, because that would be a greater Task than I can here undertake, in this short Discourse of Ethicks; but only to set down the more general Remedies, to repress their force, and to overcome their Excesses.

II. We are to examine things before that we give way to any Passion about them.

And here the First thing we meet with is, that we cautiously and diligently enquire into the nature of the thing that is presented to us, and that we abstain from passing a Judgment concerning it, as long as we find our selves moved by any Passion, so as to be byast thereby to one Object more than towards another. For since all the Inclinations that proceed from them, are only the effect of a confused Perception, they cannot offer any thing, that is clear or distinct to our Mind: And therefore we must endeavour, if the time permit, to turn our Thoughts to some other Matters, for a Season, until the Commotion of our Blood be over.

III. Whilst a Passion presents upon us, the contrary reasons are to be noted.

I said, if the time permits, because when the Passion is violent, and the case requires, that without any delay, a present Resolution be taken; the Will must consider and weigh the Reasons, that oppose the said Passion, tho' it may be they appear inconsiderable and of small moment to us. For we are to lay this down for a certain truth, That the Passions are deceitful, and that their main drift is to impose upon us, and lead us into Errors. And tho' it may seem to be a very difficult thing, after that a Passion hath made its onset upon us, and put our Blood into a Commotion, to put a stop to the Course of the Animal Spirits into the Muscles, in order to execute the command of our Passions; yet is it not a thing impossible, but may be performed, by diverting our Mind from the thoughts it is upon, by representing to it the contrary Reasons. Thus when an Enemy sets upon us at unawares, such a suddain event affords us no time to deliberate: Wherefore in this case, if we find our selves seized with Fear, our business must be to turn our thoughts from the consideration of the danger we are in, by listening to those Reasons that tell us, that there is both more Safety and Honour in resisting an Adversary, than in giving way to him, or turning our back upon him. And on the contrary, when Anger seizeth us, and that we find our selves provoked to Revenge, and rashly to rush upon our Enemy, we must call to Mind, that it is a piece of great Imprudence to cast our selves away, when as we may preserve our Lives without Shame or Infamy, and that it is no Shame for a Man to recant, or to submit himself where the match is unequal, rather than to rush on rashly upon apparent Death.

It is also very conducive to the governing of our Passions, to accustom our selves, whilst we are in a sedate and tranquil temper of Mind, to weigh and examin all the Good and Evil things, that any way may happen throughout our whole course of Life, and to discuss their nature and value, that afterwards upon occasion, we may be able with more readiness to form true Judgments concerning them, and certainly and without any hesitation discern, what ought to be avoided, and what to be embraced by us, whatsoever any rising Passion or Supervening reasons, may inlinate or suggest to the contrary. For if we direct and govern all the Actions of our Life, according to some certain and premeditated Judgments, it will not be difficult for us to repress the Violence of our Boiling Passions, and to break the force of them. For how weak soever we may be, and how easy soever to be overcome by our Passions; yet if we do but apply our selves to such thoughts as these, and often revolve them in our Minds, we shall at last come off Conquerors, and attain to an absolute Dominion over our Passions.

It will be of great use also towards the taming of our Passions, to curb our Desires, and not suffer them to Rove beyond the requiring of Nature. For tho' Desire be a peculiar Passion, yet it mingles some way or other with them all, so that he who can tame its unruliness, will easily cure the Distempers of all the rest. For all the motions of Desire as they are Solitary, and by themselves, are dark and languishing, except they receive light from abroad, and chiefly from the Goodness and Excellence of the Object, about which they are conversant. And forasmuch as some of the things that are desired by us, do altogether depend upon our selves, and some upon others, and some also partly upon our selves, and partly upon others, we ought very narrowly to examine, how we ought to carry our selves with relation to these several things, and what curbs are best to be made use of to restrain the great variety of our desire.

As to those things which are in our Power, these may lawfully be desired by us, as long as our desires of them are well grounded, and proceed from Good and Vertuous motives; for seeing that they proceed from a perception of Good, and only tend to our Complement and Perfection, to endeavour the satisfaction of them, is to act conformably to Nature, and to follow the Dictates of Vertue. But who dares say, that any one can with too great eagerness pursue Vertue?

But as to things that are forein to us, and in the Power, and at the disposal of others, our desires towards them can never be faint and weak enough: Yea we must strive, as far as lies in us, altogether to abstain from the prosecution of them, having our Mind fix'd on the Contemplation of the Great GOD, by whose Providence all things are governed and dispensed, and whose Boundless Goodness, Infinite Wisdom, and Infalible Decrees are only worthy of our continual Thoughts and Attention. Wherefore we must consider, that all whatsoever happens to us is necessary, excepting only those things, which it hath pleased GOD, should alone depend upon our Wills, and which by his Decree he hath ordain'd, should by such and such ways be conveyed to us.

IV. We must examine the nature of things whilst we are Tranquil and Sedate.

V. He that can overcome desire will soon get the Dominion over all the rest of his Passions.

VI. How far we may desire the things that are in our Powers.

VII. We must not desire any thing that is in the Power of another.

And

And being thus persuaded, as we shall not desire the Goods of Fortune, so neither shall we fear its Evils; forasmuch as they are only such, by reason of our Opinion of them, and the Error of our Understanding; but shall rather willingly submit to them, as being designed for us by his unerring Providence, and infallible in their Contingency. And accordingly giving way to Time and Chance, we shall undauntedly expect whatsoever may happen to us, as being undoubtedly assured, that they cannot deprive us of the least part of any true Good we are in possession of; yea, moreover that they are very conducive to our *Beatitude*, if we know how to make use of them as we ought, and as becomes a *Philosopher*.

VIII.
We are to moderate our desires about those things which partly depend on us, and partly on others.

And as to those things which partly are in our Power, and partly at the dispose of others, such as *Health*, the Government of our Families and Administration of State Affairs, we must take care that we do not too eagerly desire the same, or be too earnestly carried out towards them, when they seem to be in our reach; but that we remember always so to curb our desires, that we only extend them to those things that are in our Power, and depend on our *Free-will*: So that if our endeavours chance to succeed, we shall obtain the thing we desire; but if not, at least we shall have the comfort that we have performed our Duty, and done what was in our Power; and therefore shall look upon them as *Impossible*, and since the obtaining of them is not in our Power, we shall suppose them not at all to belong to us.

IX.
Generosity is a great Remedy of the Passions.

Generosity may be considered as another general Remedy of our Passions, which being as it were the Key to all *Vertue*, so it is a powerful means to subdue and moderate our Affections. Now *Generosity* consists in this, that a Man do value and esteem himself to the utmost of his worth; for having this respect and consideration for himself, it will engage him not to omit any thing he ought to do, as well as from undertaking any thing unworthy the excellence and *Dignity* of his Nature. For considering that nothing properly belongs to him, besides the free disposal of his *Will* and *Choice*; and that nothing is praise-worthy or commendable in this *Life*, save only the due use thereof, he will suppose himself to have attained the highest step of *Felicity*, if he find in himself a fixt and constant Resolution and purpose to make good use of them; that is never to want a *Will*, to undertake or execute all those things, which he judgeth to be best, which in a strict and proper Sense is to follow *Vertue*. For tho' he hath this due esteem of himself, he does not therefore despise others, but rather persuades himself, that all other Men have the same Thoughts of themselves: And therefore he never undervalues other Men, and if by chance he discover any defects or *weakness* in them, he is more ready to excuse than carp at them, and to persuade himself, that they commit those Failings, not for want of a good *Will*, but for lack of knowledge, and due Information.

X.
The highest remedy against our Passions is the Love of GOD.

But the most powerful Antidote against our Affections, is the Love of GOD, which natural knowledge implants in our Souls. For this being the most pleasant and delightful of all the Passions, we can be affected with in this *Life*, and the most strong and prevalent also, it must consequently have the Power of ridding us from the Dominion

of all other Passions, and not only of curing all the Vices of the Mind, but also of removing all the bitterness of Bodily Sickness, and of sweetening all the Troubles and Afflictions of this *Life*, which are the inseparable Companions of all States and Conditions whatsoever. And how this Divine Love may be obtained by us, DES CARTES informs us in the 35 Epistle of his first Volume, to which I refer the Reader.

CHAP. XIX.

Of the Liberty of Mans Will.

After having spoken of the *Vertues*, and shewed the use of the Passions we might seem to have performed little or nothing towards a Blessed *Life*, if we should not now proceed to demonstrate, that Man is endued with a *Free-will*, and that it is in his Power to exercise *Vertue*, and make good use of his Affections. For there be some, that are so ignorant of themselves, and such negligent searchers into the source of their own Actions, that they attribute all things to a Blind Necessity or Fatality, and suppose Men to act from an imprest instinct, and that nothing is done by them which is not necessarily determined. But these Men do very well deserve to be tied to a Stake, and there last so long, till they beg those that beat them to stop their Hands, and confess that it is in their Power, to cease from beating of them, when they please.

For what is more contrary to daily experience than to believe, that it is not in our Power to Speak or hold our Peace, to stand still, or to walk, to reach forth our hand to a poor Beggar, or to pass him by unregarded? This is so notoriously manifest, that as St. AUSTIN saith, it is Sung by Shepherds on the Mountains; by Poets on Theaters, by Ballad-mongers in their Rings, by the Masters in Schools, and by all Mankind in the World. For if Men have no *Free-will*, to what purpose are Laws made? Why are Rewards promised to those that are Good, and Punishments threatened to the Bad, if the things for which they are rewarded or punished, were never in their Power, and that they sinned against their Will, or by the force of necessity performed some good service to their Country? Why are Exhortations used? Or why do we endeavour to excite men to *Vertue*, if we have no Strength of our own so to obtain it? And if like Children and Madmen, we want the power of chusing or refusing?

Moreover, if we do all things by a kind of fatal necessity, what will become of Prevarication and Sin? Or where shall we find any Transgression of the Law, if uncontrollable force be the source of our Actions, and if they be the result of Nature, and not of our Will? Necessity, say the Lawyers, makes void an Action, and he that governs, must not be in the Power of any one. It is evident therefore that Men are free, and so far at their own dispose, that when Good and Evil are set before them, they may choose that which is Good, if it be represented to them under that Notion; or Evil, yet always under the appearance of something that is Good, if the said appearance do more strike their Understanding and attract their Will: Or when two good things are propounded

I.
How that who deny the free-will of Man may be convinced.

II.
Human Affairs show that there is a Liberty of all.

III.
He that takes away mans Liberty of Will takes away Sin.

IV.
If there
be no Li-
berty of
the Will,
all Delibe-
ration is
in vain.

pounded together, they can chuse the one and leave the other, if it appear more suitable to them, and more excellent and worthy in it self.

But what need is there of so many words to make out a thing that is so Notorious and obvious almost in all *Human Actions*? There is nothing more common amongst men, than to deliberate and take *Counsel* in doubtful Affairs; not only the *Common People*, but even *Kings* themselves have recourse to this Expedient. For seeing that every one is more dull-sighted in his own business and concerns, than in those of another, *Princes* must make use of *Counsellors*, that may be unto them instead of *Hands and Eyes*, and may help them in all things. But pray, to what purpose are these *Counsellors*, if it be not in the Power of the *King* to take their Advice, or to change his Purpose? *Nature* hath made us *Teachable Creatures*, and bestowed upon us an Imperfect kind of *Reason*, which can be amended and perfected by good Institutions. And accordingly there is nothing that more strongly induceth men to love *Virtue*, and recalls *wicked Men* to that which is Right, than the *Conversation* of good Men, by whose Example *Virtue* is recommended and learn'd, and by degrees takes root in the *Heart*. But alas! how useless would it prove to converse with good Men, if it be not in our Power to imitate their *Actions*; and if for want of this *Free-will*, we cannot follow that which is Best? We must therefore be posses'd of a *Free-will* before any of these things can be advantageous to us; and as it is in our Power to recall our *Eyes* or *Mind* from any *Object*, so it is likewise in our Freedom to withdraw our *Affections*; except we will confess, that *Knowledge* was given us to no purpose at all, and that it is of no use to the governing or directing of our *Actions*.

V.
He that
takes away
the Free-
dom of
Man's Will,
banisheth
Virtue out
of the
World.

Human Society cannot subsist without *Virtue*, which being taken away, the Beautiful Order of the *World* must be overthrown, *Government* must degenerate into *Tyranny*, and all the Concerns of *Mankind* be expos'd to the tumultuous Motions of the *Passions*. Wherefore it is necessary, that *Virtue* be seated like a *Judge* over all, and to render to every one his due; to *GOD*, by *Religion*; to our *Country* and *Parents*, by *Love* and *Obedience*; to our *Fellow Citizens*, by various Offices of *Justice* and *Charity*. But take away the Liberty of our *Actions*, and all these things vanish, and there remains nothing in the *World*, but confusion and corruption of *Manners*. For how shall *Temperance* be able to contain her self, and suppress all inordinate *Desires*? What shall put *Fortitude* upon difficult and dangerous Exploits? By what means shall *Justice* pay what is due to another, and observe the *Rules* of *Equity*? If so be it is not in their power to abstain from *Pleasures* and *Lusts*, to avoid things difficult and dangerous, or to keep what is *another's* by force. We must therefore of necessity conclude, that the Power of *Free-will* hath been vouchsafed to man by *GOD*, and that in all his *Actions* he is not driven by Necessity, but led on by his own *Will*. For otherwise, why might not all the *Failures* and *Sins* of *Nature* and *Men*, be imputed to *GOD*, if he be the only *Agent* in the *World*? Or, why might not he be said to commit all *Evils* and *Crimes* that abound therein? It was therefore

necessary, that *Man* should be endued with *Liberty*, to the end that his own *Actions* might be recompens'd unto him, and he receive the *Reward* or *Punishment* due to his *Works*.

But tho' every one doth experience this power of choosing in himself, and find that his Will in its determinations, doth not depend upon any created *Agent*; yet neither must it be conceived to be utterly independent; for tho' *Free Will*, as *DESCARTES* saith, if we give heed only to our selves, cannot but be conceived as *Independent*; yet if we consider the infinite Power of *GOD*, we must of necessity believe, that all things depend on him, and that consequently our *Free Will* cannot be exempt from his Dominion. For it implies a contradiction to say, that *GOD* hath created *Men* of such a *Nature*, that the *actions* of their *Wills* are independent of his *Will*; because this is the same, as if we should say, that his *Power* is both finite and infinite. *Finite*, because there is something that does not depend on his *Will*; and *Infinite*, in that he could make that thing independent.

But as the *Knowledge* of the *Divine Existence* must not take away the certainty of our *Free Will*, so must neither the *Knowledge* of our *Free Will*, make the *Existence* of *GOD* doubtful to us. For the *Independence* which we experience, and are sensible of in our selves, and which is sufficient to make our *Actions* worthy of *Praise* or *Reproach*, is not repugnant to a dependence of another kind, according to which all things are subject to *GOD*.

If any one should object here that *Passage* of the *Romans*, *The Good that I will, I do not; but the Evil I will, that I do*; and should from thence infer, that he who does not what he *Wills*, and does what he *Wills* not, cannot be said to be free. I Answer, that this saying of the *Apostle* is to be understood of the first motions of *Concupiscence*, which are not in our Power, neither are imputed to us as *Sin*; and therefore the *Apostle* subjoins, *Now if I do that which I would not, it is no more I that do it, but Sin that dwelleth in me*; which, since it took its birth from the first *Sin* of *Man*, and that it is the Cause, and as it were, the Mother of all the *Sins* we fall into, is therefore by the *Apostle* called *Sin*. Wherefore also the *Apostle* afterwards adds; *O wretched man that I am, who shall deliver me from the Body of this Death*, that is, from the hard Yoke of *Concupiscence*; and presently after answers his own *Question*, *the Grace of God through Jesus Christ*.

CHAP. XX.

How, presupposing Gods Omnipotence, Men can abide Free in their Wills; and whether the Free Will of Man can be hindered.

FROM what hath been said in the foregoing Chapter, no small difficulty seems to arise, which must not be omitted by us. If it be true, will some say, that all things are subject to the *Divine Power*, and consequently, that all the works of our *Will* do depend on him, how then shall we be able to secure *Human Liberty*, when all things

D d d d d that

VI.
The Free-
will of
Man de-
pends upon
GOD.

VII.
The Liberty
of our Will,
doth not
make the
Existence
of GOD,
doubtful.

VIII.
An Objec-
tion an-
swer'd.

I.
An Objec-
tion against
the fore-
going
Chapter.

II.

God is said
to be a total
Cause
two several
ways.

that proceed from us are ordained by him, and cannot happen without his *Præscience*.

We shall resolve this Difficulty by saying, that *G O D* indeed is the *Total* and *Universal Cause* of all things, so that nothing can be done by any of his *Creatures* that doth not depend on him: yet is not this *Causality* of his exerted in all after one and the same manner. For in the Production of those things, to which neither our *Free Will*, nor that of any other *Created Agent* doth concur, we must say that *G O D* only had regard to his own *VWill*, according to which he absolutely determined to produce them after such a certain manner, and such a determinate time. But as to those things which the *VWill* of *Man* hath some power over, he did not singly regard his own *VWill*; but had regard also in his *Decree* to the consent of our *VWill*; and would have nothing absolutely to come to pass, without the presupposing of our Determination. For it doth not follow, that because the certain order of all *Causes* is manifest to *G O D*, that therefore nothing is left in the power of our *Free VWill*, seeing that he himself could not be ignorant of our *VWillings*; which he foreknew were the *Principles* of our *Actions*.

III.

How God
acts in Con-
surrence
with our
Liberty.

DESCARTES illustrates this by the Example of a *King* in an *Epistle* of his to *Elizabeth*, the *Princess Palatine*. Suppose we a *King* to have forbidden all *Duels*, and that he certainly knew that 2 of his *Nobles*, the inhabitants of 2 different *Cities*, had a quarrel together, and to be so incensed against each other, that in case they should chance to meet, they would certainly fight one another; if I say this *King* should command one of them to take a *Journey* towards that *City*, where the other dwells; and at the same time give the other a command to go towards that place where the former is supposed to inhabit, he certainly knows that they cannot but meet one another, and consequently fight and break his *Command* or *Proclamation*; but yet for all this he doth not force them to it; neither doth his *Knowledge*, no nor his *VWill* neither of thus determining them to this *Action*, any way hinder them from fighting as freely, as they would have fought, if he had known nothing of all these particulars, or if by any other occasion they had chanced to meet with one another; and therefore he may with as much justice punish them for violating his *Edict*.

IV.

Gods know-
ledge and
will do not
destroy
mans Li-
berty.

Now what is lawful for a *King* to do, with respect to some of the *Free Actions* of his *Subjects*, the same *G O D*, whose *Knowledge* and *Power* is infinite, doth, with regard to all the *actions* of *men*. For before ever he sent us into this *VWorld*, he exactly knew how all the *Propensions* of our *VWill*s would be, because he himself put them into us; and also disposed all things without us in such a manner, that these and the other *Objects*, should present themselves to our *Senses*, this or that time, by occasion whereof he knew that our *Free VWill* would determine us to this or the other thing. And this he would have to be so; but yet he would not force us to this. And as in the foresaid *King*, 2 different degrees of *Will* may be determined; the one whereby he would that these 2 *Nobles* should fight together, in as much as he was the cause of their meeting together; and another whereby he would it not, or was against it, in that he had forbid *Duelling* by his *Proclamation*: in like man-

ner our *Divines* distinguish 2 *VWill*s in *G O D*, the one *Absolute* and *Independent*, whereby he will have all things to come to pass as they do; the other *Relative*, which respects *mans merit*, or *Guilt*, by which he will have his *Laws* obeyed.

Three things are commonly reckoned up by *Heathen Philosophers*, which may hinder the use of our *Free VWill*, viz. *Fear*, *Ignorance* and *Force*. *Fear* seems to be an Impediment or Bar to *Liberty*, when it is not the fear of a vain man, as the *Lawyers* speak, but such as is grounded, and may light upon a constant and well resolved person, because it makes him do those things which he would never do, if he were left to himself, and were not shaken with fear.

But I do not at all approve of this Opinion, forasmuch as *Fear*, whether it be great or small, doth not so oppose *Liberty* as that it should wholly destroy it: Yea, if we heedfully mind the matter, we shall find that it is always in conjunction with a kind of *VWillingness*, whereby it willingly performs that which *Fear* seems to extort from it. For 2 things are considered in *Free VWill*; First, That we do it spontaneously, or of our selves: And Secondly, That we do it freely. The former of these *Modes of Acting* seems in some sort to be hindered by *Fear*; because we do that, which we would not, if we were not forced to it by the *Fear* of some impending Evil. But the latter is not at all hindered by it, because the nature of *Free VWill* doth not consist in *Indifferency*, seeing that we do nothing so voluntarily and freely, as we do those things to which we are determined by an urgent Cause. As we see it happens to us when we are egg'd on by *Fear*; for though the Object then be displeasing to us, and that we would rather, if we might, choose the contrary; yet because of the impending Evil or Punishment we do greedily embrace it, and choose a lesser Evil before a greater. And therefore *Lawyers* are of opinion, that all *Contracts* are not made void by *Fear*, except they be accompanied with *Injustice* as appears *Instit. de Except. in Initio. Ex L. Mulier. S. finit quod metus causa. Ex L. ultima C. de iis qua vi*, and innumerable other places.

As concerning *Ignorance*, we shall the better be able to determine, how it may be said to hinder the use of our *Free VWill*, by supposing a twofold *Ignorance*, Vincible and Invincible. Vincible *Ignorance* is that, which by the use of moral and due Diligence may easily be overcome. Now a due Diligence is that which ariseth from *Vertue*, or the Love of *Reason*, and not from any other ground or motive. As by Example, a *Merchant* having an usual *Contract* or *Bargain* offer'd him, doth not examine it, only seeing that he is like to gain by it, embraceth it, without any more ado, or concerning himself any further about it: and forasmuch as he hath not examined it, he doth not know it to be unjust. Now this *Ignorance* of the *Merchant* in Vincible, and doth not consist with *Vertue*; for if he had loved *Reason* above all things, he would have diligently examined the said *Contract*, and having found it to be offensive to *Reason*, he ought never to have consented to it, how gainful soever it might appear to be otherwise. But *Invincible Ignorance* is when a man cannot know that he is ignorant of, in the circumstances

V.

There be
3 things
that hin-
der the use
of our Free
Will.

VI.

Mans Li-
berty may
consist with
Fear.

VII.

Of two-
fold Ig-
norance Vin-
cible and
Invincible.

stances wherein he is for that time. As for Example, suppose we that SEJUS hath writ to his Friend CAJUS to assist him in such a *Business*, and that the Letter chance to miscarry, and never come to his *Hands*; in this case CAJUS will be under an *Invincible Ignorance*, tho' he hath used no diligence to the removing of it.

Ignorance, with respect to a *Free Act* is found to be threefold. I. *Antecedent*, which is before any consent of the *Will*, and this without doubt is *invincible*, neither can any blame be imputed to it: As if a man that is a *Hunting* should kill a *Man*, taking him to be a *Beast*; because 'tis supposed that he never intended any such thing. The other is *Concomitant*, which exists together with the *Act*, and doth accompany it, inasmuch that it is the *Principle* of that *Action*; and the *Action* would have follow'd, tho' the said *Concomitant Ignorance* had not been: As if a man supposing himself to kill a *Beast*, should ignorantly kill his *Rival*, whom he hates from his Heart; and whom, if that *Ignorance* had not been, he would have kill'd notwithstanding. The *Third* sort of *Ignorance*, is *Consequent*; so called, because it follows the *Consent* of the *Will*, and therefore *Voluntary*, and therefore is somewhat of the same Nature as *Invincible Ignorance*: As when a man forbears going to *Church*, because by Neglect he never minds or enquires about the Time when he is to go. From these things thus briefly stated, it is apparent, that it is only *Invincible Antecedent Ignorance* that can make an *Action* *Involuntary*, since whatsoever follows from it was altogether unknown. For nothing is *desir'd* of *Man*, which is not first *known* by him: For the *Understanding* is like a *Servant*, that carries a *Torch* before his *Mistress*, the *Will*.

But here we are to observe, that there can be no *Invincible Ignorance* of the *Law of Nature*, which by *Natural Instinct* is known to all; and therefore whosoever he be that transgresseth the same, can never be blameless. Whence is that *Common Saying* of the *Philosophers*, *Ignorance of the Law excuseth no man*: But that the *Ignorance* of *Positive Law*, whether *Human*, *Ecclesiastical*, or *Divine*, may render an *Action* *Involuntary*.

It remains next to be explained, whether there can be any Force or Violence that is capable of making the *Actions* of our *Will* *Involuntary*. To the better solving whereof, we are to suppose that *Human Actions* are twofold, *Elicit* and *Imperate*: Those are called *Elicit Actions*, which are immediately produced by the *Mind*, as from their *Principle*; such as are the *Acts* of *Nilling* and *Willing*. Others are *Imperate*, which proceed from another *Faculty* than the *Will*, tho' not without the *Command* of the *Will*, as *sensible Perceptions*, the *motions* of the outward *Members*. As to the first of these, it is evident that the *Will* cannot suffer any Violence, or that the *Elicit Acts* of the *Will* should be forced; for seeing that they proceed from the *Will*, as from their *Active Cause*, they cannot be subject to any Violence that proceeds from an *Outward Principle*, as *ARISTOTLE* saith, which can add no Force to the *Action*, since it is evident that the *Will* is an *Active Principle*, and adds or contributes to its own *Acts*.

But as for the *Imperate Acts* of the *Will*, they may be said to be *Involuntary*; for tho' they depend on the *Command* of the *Will*, and follow its *Inclination*, yet the *Faculties*, especially the outward *Members*, may be so hindred by the Force of an *External Agent*, that they cannot execute the *Command* of the *Will*; and accordingly we frequently find some *motions* produc'd in our *Bodies*, contrary to our *Will*s.

CHAP. XXI.

Of Human Acts, and of the Goodness and Pravity of them.

BY the Name of *Human Act*, every *Action* is not be understood that proceeds from *Man*, but that alone which is the effect of a *Free Principle* of *Acting*, or which is caused by the *Understanding* and *Will*. So that that is only to be accounted as an *Human Action*, whereof a *Man* is the *Absolute Lord* or *Disposer*, or which he hath in his *free Power*.

There be 2 *Principles* that concur to every *Human Action*, viz. *Understanding* and *Will*. The *Understanding* that shews the Way, and, as it were, carries a Light before his *Mistress*. For tho' the *Will* be an *Elective Faculty*, by which the *Mind* freely determines it self to doing, or not doing; yet it is first required, that the *Understanding* do before represent or propose the thing to her. For as nothing in general can be willed, except it be known; so nothing can be freely Will'd, except it be fore-known by the *Understanding*. Wherefore every *Error* that befalls our *Actions*, is chiefly caused from the wrong *Perception* of the *Intellect*: For if she never did exhibit ought to the *Mind*, but what was clear and evident, neither would the *Will* ever mistake in her *Choice*.

In every *Human Action* a twofold *Goodness* may be observed; the one *Natural*, which some call *Entitative*, which is in all things, inasmuch as they are partakers of *Nature* and *Entity*. The other *Moral*, which is nothing else but the *Conformity* of a *Human Action*, with *Right Reason*. As on the contrary, the *Moral Evil* or *Pravity* of an *Action*, is its deformity or swerving from *Right Reason*, that is, when it wants any *Perfection*, which according to *Right Reason* it ought to have. By *Right Reason*, I understand here a true *Judgment* of every thing, free from the *Paint* or *Fucus* of any *Opinions*, whereby the *Laws* of *GOD* and *Nature* are understood, and every thing rightly and prudently discerned, according to the *Prescript* of the *Law*. Whence it appears, that many *Actions* which agree with regard to *Nature*, do extremely differ with respect to *Manners*. As for Example, To kill a man, when it is done of a Mans own *Will* and *Authority*, is not distinguishable from that *Action*, whereby a man is put to *Death* by *Publick Authority*; but they vastly differ in a *Moral* respect, seeing it is lawful to Kill a man by *Publick Authority*, because of the *Justice* which is exercised in that act, whereby it comes under the *Notion* of *Good*; whereas to Kill a man by the impulse and instigation of ones own *Will*, is unjust and prohibited by the *Law* of *GOD*.

XI.
But Imperate Acts may.

I.
What an Human Action properly is, and what Principles concur to it.

II.
Two things are required to a Human Action.

III.
Of the Twofold Goodness that is found in Human Actions.

An

VIII.
How or in what case Ignorance doth excuse a Transgressor.

IX.
Ignorance of the Law of Nature cannot be Invincible.

X.
The Elicit Acts of the Will cannot be forced.

IV.
What
makes any
Action
Morally
Good.

An *Action* therefore is accounted Morally Good, if it respect or have an Eye to *Good*, desired according to *Right Reason*. For *Human Actions* derive their Goodness from their *Object*, when it is supposed to be such as *Right Reason* prescribes and allows of: Forasmuch as an *Action* is not accounted Good, because the *Understanding* knows it, and the *Will* rightly desires it; but rather because the *Object* of it is good and honest, therefore the *Will* that is carried towards it is *Right*. Wherefore *Right Manners* do not make the *Object* Good and *Honest*; but on the contrary, a *Good Object* and agreeable to Reason, makes good *Manners*, and consequently *Human Actions* derive the formality of their Goodness or Pravity from it. And the same is to be said of *Evil Actions*, which owe their *Evil* to a shameful and dishonest *Object*; and accordingly the more shameful the *Object*, the more wicked is the *Action*. And forasmuch as all *Objects* are not Equal, but some excel others in Pravity, so neither can it be said that all Sins are Equal, it being certain that some far exceed others in *Evil*.

V.
The Good-
ness or
Pravity
of Actions
depends on
certain
Circum-
stances.

Neither doth the *Good* or *Evil* of *Human Actions*, solely depend upon the *Object*, but also on certain *Circumstances*; which are so called, because they always accompany, and as it were, guard and encompass our *Actions*, especially those that are outward, and are, as it were, so many Accidents observable in them. Of these there are commonly reckon'd up *Seven*, which are contained in these Verses.

*Who, what, where, by what means; why, how and when,
These make or Good or Bad all Acts of Men.*

VI.
Who.

Who, denotes the Person and Quality of the *Agent*; as whether, he who hath committed a Rape be a *King* or a *Subject*, a *Citizen* or a *Stranger*, a *single* or a *married Man*.

VII.
What.

What, intimates the Quality of the *Object*, about which the *Action* is conversant, whether the party on whom the Rape hath been committed, be a *Virgin* dedicated to *GOD*, or one at her own dispose.

VIII.
Where.

Where, shews the place where the Wickedness hath been committed, whether in the *Church* or in a *Profane place*.

IX.
By what
mean.

By what means, points us to the Instruments or Companions a *Man* hath made use of in the committing of this Wickedness. As, whether he struck with a *Sword*, or with a *Stick*; whether he had any to assist him, and whether they were *Clergy-men* or *Laicks*.

X.
Why.

Why, makes out the Intention of the *Agent*; as whether a *Man* set upon another merely for gain, or to revenge an Injury.

XI.
How.

How, holds forth the manner of the *Action*; as whether a *Man* did hurt or wound another, being provoked by *Wrath*, or in his right Wits; whether he assaulted him basely and treacherously or fairly and openly.

XII.
When.

When, considers the Time when the *Action* was done, whether in the *Night* or in the *Day* time.

XIII.
Circum-
stances do
often

Which *Circumstances* are therefore said to concur to *Human Actions*, forasmuch as some of them do very signally increase the goodness or pravity of

them, yea, and sometimes quite change the kind of them. As for Example, when that which is stolen is something dedicated to *GOD*, or his Worship; this is not simply *Theft*, but *Sacrilege*, which differs in kind from *Theft*, as being supposed forbid by a Special Precept. And in such a case as this they lose the Nature of *Circumstances*, and take upon them the Nature of an *Object*, whence, as we said before, *Human Actions* derive their Pravity, and becomes worthy of Punishment.

Tho' the *Duties* of a *Man* and *Citizen* might seem to require a particular Place wherein to be treated of and so to constitute the Eleventh Part of this Institution; yet forasmuch as they belong to *Human Actions*, and presuppose *Free-will*, I have thought fit to subjoin them here; and keeping my self within the Number of these Ten Parts, to Treat of them by way of Conclusion. For this *Work* might well seem to be deficient, if after having explained the Nature of *Vertue*, (which according to the common Division we have distinguish'd into 4 Heads) and having enquir'd into the Nature of *Human Actions*, we should omit the *Offices* and *Duties* of *Men*, and not amply and distinctly Treat of these, which are the Consequents of his *Liberty*. Wherefore we shall now set down, what are the *Duties* of *Man* in General, and afterwards proceed to the *Offices* of a *Good Citizen*, and shew what either of them ought to embrace as *Good* and *Vertuous*, and to reject as *Shameful* and *Wicked*, according to the Precept of *Nature*; which I shall endeavour to perform with all the Brevity possible, and as far as the Bounds of this Institution will permit.

CHAP. XXII.

Of the Rule of Human Actions.

Since to the end a *Man* may act aright, it is necessary that he be Conscious of his *Actions*, or, which is the same, that he assent to his own Reason in the Chusing or Avoiding what is propounded to him; it will be of use to us to know what *Conscience* is, and by what Denominations it goes: As likewise what *Obligation* is, to whom it agrees; and how it comes to pass, that *Mankind* is bound to observe some *Institutions*.

By the Word *CONSCIENCE* we here understand, that Testification or Witnessing to *Good* or *Evil*, which every one experienceth in his own Mind: Or, as some describe it, it is that Act of the Intellect whereby a *Man* judgeth, that a thing ought, or ought not to be done. And this Act or *Conscience*, is denoted by several Names, according to the *Motives* or *Reasons*, whereby it is egg'd on.

It is called *Right*, when the *Human Understanding* is so well informed of things that are to be done or omitted, that it can give clear and distinct *Reasons* of its *Perceptions*, and such as cannot be doubted of or call'd in Question. Or, to express the same in fewer Words, which dictates that to be *Good*, which is Good; and that to be *Evil*, which is really so. And such a *Conscience* as this, is but rarely found amongst men, there being but very few that know the Causes of things, and that are so happy as to be able to reduce them to their Principles.

change the
very kind
of the
Action.

XIV.
Of the
Duties and
Offices, as
well of
Man in
common,
as of a
good Chri-
stian in
particular.

I.
What
things are
to be fore-
known in
this mat-
ter.

II.
What Con-
science is.

III.
A Right
Conscience.

We

IV.
A Probable
Conscience.

We call that a *Probable Conscience*, when tho' we do truly assent to the *thing* offer'd to us, and do think that the same ought to be embraced or declined; yet we are not able to make out our *Judgment* by *Reasons*, but only derive the same either from the Authority of our *Superiours*, or received *Custom*, or the common tenour or course of a *Civill Life*.

V.
A Doubtful
Conscience.

A *Conscience* is said to be *Doubtful*, when it hangs, as it were, in equal poize or wavering, and doth not know which part to assent to: Which more especially is found in singular Cases; where *Reasons* on both sides present themselves, and we cannot discern which are to be prefer'd. Now in such a case as this, we do well to suspend our *Judgment* without determining any thing till the *Darkness* of our *Mind* be dispell'd, and that it clearly appear to us, what is consonant to the *Law* before us, and what is contrary to it.

VI.
An Erroneous
Conscience.

Lastly, We call that an *Erroneous Conscience*, when our *Understanding* embraceth *Evil*, instead of *Good*, or declines *Good* instead of *Evil*. And this either through *Vincible* or *Invincible Error*. *Vincible Error* is that which we may avoid by a diligent and careful Examination of the Case. *Invincible*, is that, which we cannot avoid by any care or diligence that it is possible for us to take. But this last *Ignorance* happens only in particular Affairs, which depending of many *Circumstances*, it frequently comes to pass, that we are deceived about them, or about the *Object* it self, and so fall into *Error* against our *Wills*.

VII.
What Ob-
ligation is.

By the word *Obligation*, we are to understand nothing else, but that Tye of the *Law*, whereby we are of necessity compell'd to do something. For by it we do, as it were, gird up our *Free-will*, and tho' we very well know our selves to be free, and that we can chuse the contrary to what is propounded to us: Yet there is a kind of *Co-active Power* that sticks to our *Minds*, by means of the *Obligation*, which doth not suffer us to incline to it, and puts us in *mind*, that we shall sorely repent of it afterwards, in case we do not act according to the *Prescript* of the *Law*.

VIII.
Man alone,
of all other
Animals,
is capable
of Obliga-
tion.

Amongst all *Animals*, *Man* only can be the Subject of *Obligation*: For *Beasts* being devoid of *Reason*, and destitute of the *Faculties* of the *Will*, can exert no free *Actions*; and therefore it would be in vain, to prescribe any *Form* to their *Actions*, seeing they can neither understand it, nor adjust their *Actions* by it. *Man* only therefore is capable of *Obligation*, and of receiving a *Rule* prescrib'd by his *Superiour* to Live by. I say, by his *Superiour*; for if a *man* were of such a Condition, as to be wholly at his own dispose, without being obnoxious to the Command of any, he could not be obliged to the performing of any thing by any *Law*; and if in that *State* he should follow the dictates of *Reason*, and abstain from some things; this would be imputable rather to his most *Free-will*, than to any *Obligation* lying upon him.

IX.
How a
Superiour
is to oblige
those that
are under
his Com-
mand.

Now to the end that this *Obligation* may be the more firmly impress'd upon the *Mind* of *man*, besides the *Authority* of the *Superiour*, it is sometimes fitting that *Just Causes* should be produced by him, which induce him to put this *Curb* or *Restraint* upon the *Liberty* of his *Subject*. For

he that only shews his *Power*, and will always have his *Will* to stand instead of *Reason*, may indeed strike *Fear* into a *Man*, and make him rather chuse to obey him, than to expose himself to danger: But when once this *Fear* is gone, and that the *Superiour* ceaseth to be frightful to him, he will soon return to his own *Inclinations*, and follow the *Motions* of his own *Will*; rather than those of another. But when the *Reasons* are discover'd, why he thinks fit to circumscribe the *Liberty* of his *Subject*; and that he makes it out, that it is his *Interest* that such *Laws* should be Enacted; yea, that many *Advantages* will thereby accrue to him, he will readily submit himself to them, and shew himself ready to obey his *Princes Commands*.

The *Rule* therefore which every *man* is to follow in his *Actions*, is the *Law* or *Decree*, whereby the *Sovereign*, in whom the *Publick Power* is lodg'd, binds up his *Subjects*, to order and regulate their *Actions*, according to his *Prescript*. Now that such a *Law* may be able to compel *men*, and exert its *Force* upon their *Minds*, it is necessary that the *Legislator* and his *Laws* should be known to them. For how will any one be able to pay *Obedience* to them, if they have no certain Knowledge, neither of the *Person* to whom they are to render it, nor to what they are obliged? True it is, that the *Laws of Nature* are engraven on the *Hearts* of all *men*, and are so many *Precepts* that are common to all *Nature*, and that no *Man* in his *Right Understanding* can be ignorant of the *Author* of them: But *Civill Laws* are not alike *Notorious*, as depending upon the *Free-will* of *Superiours*, as being such to which only some peculiar *People* are obliged; and therefore in order to their being of *Force*, they must be promulged and made known to all their *Subjects*. Which *Promulgation* is performed, either by the *Voice* of the *Legislator* himself, or by some of his *Deputies*, whose *Authority* is unquestionable; or any other way, according to the various *Customs* of different *Provinces* and *Kingdoms*.

Every *Law*, if it be perfect, contains 2 Parts: The one which determines what is to be done or omitted; the other, which declares the *Punishment* to be inflicted upon those that neglect to perform what is prescribed, or commit what is forbid. For seeing that *Human Nature* is prone to *Evil*, and is apt to be carried with more vehemence to things that are forbid, it would be to little purpose for any *man* to declare what is to be done, if there were no *Punishment* to follow the *Contemner* of the said *Command*: And so in like manner, it would be altogether to no purpose to threaten any *Punishment*, if there were not cause specified before, for which the said *Punishment* is to be inflicted.

Notwithstanding that *Laws* seem to restrain the *Liberty* of the *Subject*, yet they are so to be ordered, as that whatsoever is prescribed, may appear to be profitable and advantageous to the *Publick Good*. For it would seem unjust to oblige *Subjects* to the Observance of any thing that is not advantageous thereunto. Forasmuch as *Laws* are like *Remedies*, which ought always to be conducive to the good State of the *Body*, because they are appointed for that end: And in like manner, there ought to be nothing in the *Laws*, which doth

E e e e e

not

X.
The Rule
of Human
Actions.

XI.
There are
two things
in every
Law.

XII.
Laws are
to be En-
acted for
the Publick
Good.

not contribute to the good of the *Community*, because it is for that Reason that they were Enacted.

XIII.
The Legislator may dispense with the observance of the Law.

Tho' the Law be suppos'd a *Common Precept*, and a *common Contract* or Agreement (as the *Lawyers* express it) of the *Commonwealth*, according to the *Prescript* whereof those that live in the *Commonwealth* are to regulate themselves; yet some *Persons* may be peculiarly exempted from the observance of it; and this is express'd by the word *Dispensing*. The Power whereof belongs only to the *Legislator*, who as he hath the Power of Enacting *Laws*; so he only hath the Power of Abrogating or Dispensing with them, that is, delivering any one from the obligation of them. But above all things, it is the *Duty* of the *Sovereign* never ordinarily, or without urgent Cause to free any of his *Subjects* from the obligation of the *Law*; to avoid the *Envy* and *Indignation* this would be apt to cause amongst their *Fellow Citizens*.

XIV.
The Difference of Actions.

From what hath been said, may be gather'd, that *Human Actions*, as they have a relation to the *Prescript* of *Laws*, do take to them several *Qualities* and *Denominations*. For those which the *Laws* pass by, without determining any thing concerning them, are called *Permitted* or *Lawful*, as long as they are not contrary to the *Law* of *Nature*, or the *Reason* that is in *man*. The *Actions* that are conform to the *Laws*, and follow the *Rules* prescribed by it, are called *Good*; and those *Evil*, which are contrary to it.

XV.
When Actions are said to be Good.

Now to the Goodness of an *Action*, it is requisite not only that it agree with the *Law* in some part, but that it be in all things conform to it: Whereas it is sufficient to the Pravity of an *Action*, if it be deficient in some one part only, and does not in all respect, agree with the *Law*.

XVI.
The Divine and Human Law.

The *Law*, as it is a Regulation of *Reason*, shewing *Man* what he ought to do, and what not, is twofold, *Divine* and *Human*. That is called the *Divine Law*, which is instituted immediately by *GOD* himself. And therefore *ARISTOTLE* saith, in his *Third Book* of *Politicks*, *He who commands the Law to bear Rule, commands that GOD should bear Rule*. *Human Law* is that which is Enacted by *men*, and is different according to the different Form of the *Government Politick*. Of which I have treated more at large in the *Chapter* of the *Law* of *Nature*.

CHAP. XXIII.

Of the Duty of Man towards GOD.

I.
Of the three general Duties, or Offices of Man.

THE *Action*, which according to the *Nature* of the *Obligation* that lies upon us, we are to regulate according to the *Prescript* of the *Laws*, is divided into 3 Chief Parts, according to the several *Objects* it respects. The first whereof shews, how according to the sole Guidance of *Nature*, we are to carry our selves towards *GOD*; the other, how we are to demean our selves with regard to our selves; the last, how we are to comport our selves towards other men. For the whole *Obligation* of *Man* is compriz'd in these 3 *Duties*; so that he may be said to have performed whatsoever appertains to him, if he carries himself *Piously* towards *GOD*, *Prudently* to-

wards Himself, and Equally towards his Neighbour. Wherefore seeing that the *Duties* we owe to *GOD*, do precede the other 2, we shall first speak of them, and afterwards proceed to the other.

The *Laws* whereby *Man* is obliged towards *GOD*, may be reduced to 2 Heads: First, That he have right Thoughts concerning *GOD*, and a true Idea of his *Nature* and *Perfections*. In the next place, that he resign and conform his own Will to the *Divine*; and that he look upon it as the greatest of Crimes, to deviate in the least from his Good Pleasure. And from these two parts of *Man's Duty* towards *GOD*, many Propositions, both *Theoretical* and *Practical*, may be deduced, whereon *Natural Religion* is founded, and by which, according to the Etymology of the word, *Religion*, a man is ty'd and obliged.

The First thing we are to hold concerning *GOD* is, that he *Exists*; that is, that he hath an *Actual Existence*, and is the *Principle* of all other things. This being no more, but what is demonstrated to us by the *Amplitude* and vast Extent of the *Universe*, the unconceivable Variety of it, and the *Beauty* and *Harmony* of its Parts; since none of all these could have the constant Continuance and Regularity they are found in, except the *World* were at the Command of a most *Wise Governor*, and did persevere by an immutable *Law*. By this *Contemplation* alone of the *World*, the *Philosophers* of old attain'd to the Knowledge of *GOD*, as being fully convinc'd, that such an *Exquisite* and most absolute *Work*, could not proceed from less than an *Omnipotent* and most *Perfect Being*. If some *Modern men*, that aspire to that *Name*, seem to be of another *Opinion*, it is to be attributed to their *Ignorance*. For as a confus'd Perception of things, and *Superficial Knowledge* incline men to *Atheism*; so a clear and profound Knowledge of things, raiseth the *Mind* to the *Veneration* of *GOD*, and not only excites it, but even strongly compels it thereto. 'Tis the *Fool* only that saith in his Heart, there is no *GOD*. For whole Mankind, from the very Beginning, ever was in perpetual possession of this *Truth*, seeing there was never any *Nation*, (as *TULLY* expresseth it) so *Barbarous* or *Savage*, that did not own a *GOD*, tho' it may be they were not able to determine what kind of Being he must be. And accordingly *JUSTINIAN*, 2 *F. de Just. & Jur.* reckons *Religion* towards *GOD*, amongst the *Laws* of *Nature*, and the *Right* of *Nations*; forasmuch as all *Nations* agree in a general *Worship* of *GOD*, and, as it were, by the Attraction of this common *Principle*, are united and reconciled.

The Second is, That *GOD* is the *Creator* of the *World*, and that nothing is to be found in it, whereof he is not the *Author*. For since this glorious *Fabrick* of the *Universe* could not be its own Cause, what Contrivance, what *Engines*, what *Leavers*, what *Servants* could be employ'd in the Production of it, but the *Omnipotence* of *GOD* himself? Hence appears the Ridiculous and stupid folly of the *EPICUREANS*, who suppose that so many *Miracles* were the product, not of the *Divine Reason*, but of the fortuitous concurrence of *Atoms*. For how could these *Atoms*, in those immense Spaces, meet in such

II.
What is Man's Duty towards GOD.

III.
The First thing we are to hold concerning GOD.

IV.
The Second thing is, that GOD is the Creator of the World.



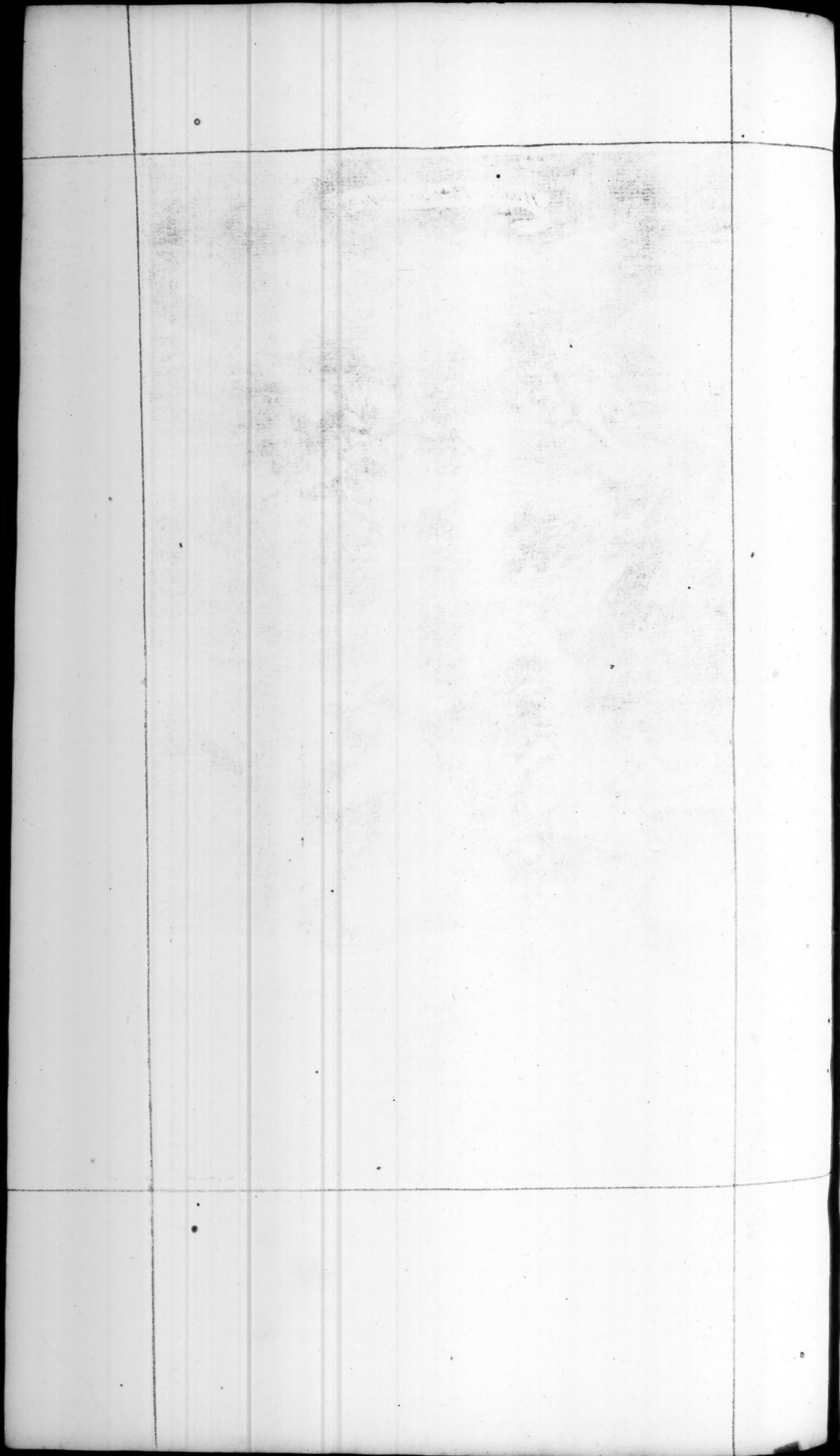
To the Right
Edwards of the City

This Plate is humbly



Worshipfull S.^r James
of Yorke Baronet

Dedicated by Richard Blome



a manner, and be adapted together, as to compose *Animals* and *Man*, whereas we see they cannot be produced without the mediation of *Seed*? What Cause was there to dispose them rather to the forming of this *Body*, than another? What was there to determine them to the constituting of *Bones, Flesh, Marrow, Veins, Arteries, Nerves, Humours, Tendons, &c.*? We must therefore acknowledge a *Special Principle*, by whose Power this *World* was framed, and all the parts of it digested in the comly Order in which we see them.

V.
Thirdly,
That He
is the
Preserver
of the
World.

The *Third thing* we are to hold concerning *GOD*, is, that he is the *Governour* and *Preserver* of the *Universe*. As is evident from the admirable Order and Agreement of the Parts of it, which could not continue so long invariable, if they were not by some *Supream Cause* preserved in the same Condition. For daily Experience teacheth us, that whatsoever is made up of different Things, and are endued with different Powers, do stand in need of an *Upholder*, and will easily run into Confusion, except they be supported by an *External Agent*, and their Parts kept in their due Stations. And therefore the *Ancients* were of Opinion, that *GOD* had somewhat of the same place in the *World*, as a *Coach-man* in a *Coach*, the *Singing-Master* in a *Choir*, the *Steers-man* in a *Ship*, the *Father* in a *Family*, and a *King* in his *Kingdom*. And that consequently, those who deny that *GOD* takes care of this *World*, and that all things therein are managed by his Conduct, are as Criminal Delinquents against his *Divine Majesty*, as they who say, there is no *GOD* at all.

VI.
And, that
he hath a
Special care
of Man-
kind.

We are likewise to consider, that *GOD* not only Governs the whole *World*; but that he also Exerciseth a more *Special Conduct* towards *Man-kind*, and that he is the *Immutable Cause* of all the Actions which depend on the *Free-will* of *Man*. For since it cannot be demonstrated, that he doth *Exist*, except that he be considered as a most *Perfect Being*; and that he could not be so, if there were any thing in the *World* that did not proceed from him; consequently we can prove from *Natural Philosophy* alone, that not the least *Thought* can enter into the *Soul* of *Man*, without the Will of *GOD*, and except *GOD* had Willed it should from all Eternity.

VII.
Fourthly,
That he is
most highly
Perfect.

The *Fourth thing* we are to be persuaded concerning *GOD*, is, that he is *Sovereignly Perfect*, and that no *Attribute* belongs to him that implies the least defect. For seeing that he is *Infinite*, he must of necessity include all those Perfections which the *Mind* of *Man* is capable of Conceiving; and consequently we must own him to be *Sovereignly Good* and *Wise, Eternal, Omnipotent, Immense*, and so *Perfect*, that it is equally impossible to add any thing to Him, or take any thing from Him. But forasmuch as the *Divine Perfections* cannot be comprehended by any *Human Understanding*, in order to the Expressing of them, we shall make use of such Terms, as shall more magnificently unfold his *Supream Excellence*, and impress upon us a greater Veneration. For when we hear that *GOD* is *One, Immense, Incorporeal, Immortal, Infinite, Incomprehensible, &c.* we seem to launch into a Boundless Ocean of Perfections, and are forced to confess, that the Amplitude of such an *Essence* can by no means be reached by our *Intellect*.

And accordingly they Sin against the *Law of Nature*, who say, that *GOD* sees things, before ever he did determine himself to Will them; that he consults the Order of his Acting, before he Acts; that his Will indeed is, that there should be no Monsters; but that the simplicity of the *Laws of Motion* doth necessitate him to suffer them; and other such like, which import Dependence and Imperfection in *GOD*.

Wherefore we are to remove from Him whatsoever implies any Limitation or Defect, and all those Affections which imply or suppose the want or absence of any Good. And if we find, that Passions are sometimes attributed to *GOD*, as when the *Scripture* speaks of his *Favour* and *Munificence* towards those that are Good, and his *Vengeance* against the *Wicked*; we are to remember that the *Scripture* in these Expressions, accommodates its self to the Capacity of our *Human Understanding*. In like manner we find, that *Holy Writ* attributes to *GOD*, *Wrath, Jealousy, Indignation, &c.* by a *Metaphorical* way of Expression accommodated to our Weakness, and rather designing to represent to us the Effect of that Affection, than the Affection it self.

In like manner, those also Sin against the *Law of Nature*, who attribute to *GOD* any Figure; because every Figure is determined and bounded: Those who say, that *GOD* is composed of Parts, or that he is a *Whole*; because all these ways of Speaking import Attributes that belong to *Finite things*; and those also who say, that *GOD* is in a Place, because nothing can be in a Place, but must have its Greatness or Bulk bounded on every side. Those also Sin against the same *Law*, who assert, That *GOD* Moves himself, or that he Rests, because both these suppose the being in a Place, which is inconsistent with *GOD*.

Neither is it enough for *Man* to know *GOD*, but he must also worship and celebrate him. For the *Practical Propositions* whereof *Natural Religion* doth consist, are conversant about the *Worship* that is due to *GOD*, which is partly in the *Mind* of *Man*, and partly without it; that is, either Inward or Outward. By the *Inward Worship*, we understand the Honour that is to be given to *GOD*, in consideration of his Power, in Conjunction with Goodness. For Veneration, as was said before, is an Inclination of the *Soul*, not only to have high Thoughts of *GOD*, whom it worships; but also to submit and resign it self to him, with a kind of *Awful Fear*, to obtain his Favour. And therefore no *Man* Honours *GOD* more, or serves him with a purer *Worship*, than he, who by the *Holiness* and *Innocence* of his Life endeavours to become like him, and would rather dye a thousand Deaths, than to suffer that *Holy Image* of *GOD*, which he discerns and owns within himself, to be defiled by any Crimes, or stained with any the least Vice or Immorality. And from the Consideration of his *Glorious Majesty*, he is stirred up to desire him, as his *Author* or *Maker*; to love and call upon him, as his *Father*; to honour him, as his *King*; and to fear and reverence him, as his *Lord*.

In order to the easie acquiring of this *Habit* of Loving of *GOD*, and the having a most profound Fear and Reverence for him; we must frequently reflect, that *GOD* commands us nothing, but what is for our Profit or Advantage, and that his Power

VIII.
Nothing
must be
attributed
to GOD,
that in-
cludes ei-
ther De-
pendance or
Imperfe-
ction.

IX.
We must
remove
from GOD
every Im-
perfection.

X.
Such as
Figure,
Motion,
Parts,
Place, &c.

XI.
GOD is to
be Honoured
by Man.

XII.
After what
manner
GOD is to
be beloved
by us.

and Goodness are so Great, that He hath Created an infinite Number of *Beings*, which serve for our Preservation; which Consideration will fill us with so much *Admiration, Respect* and *Gratitude* for our Great GOD, that knowing him to be the Source of all True Good, we only and above all things shall desire to be united to him with our *Wills*, and to love him in the most perfect manner possible.

XIII.
Wish Out-
ward
Worship.

Neither are we only to render unto GOD the *Inward worship* of our *Hearts*; but we must also give unto him that which is *Outward*; which we then do, when in Thankful Remembrance of his Benefits, we render Thanks unto him, and acknowledge him to be our Beneficent Father, GOD and LORD; and by our *Hearts* or *Eyes* also lifted up unto *Heaven*, do admire his *Power* and praise his most *Holy Majesty*. When in a deep sense of our own Infirmities, we pray unto him, implore his Assistance, and humbly beseech him to help and succour our *Infirmities*; and that he would be pleased to bestow upon us those things he knows to be good for us, and to turn away from us all things that are *hurtful*. Whilst we abandon and resign our selves wholly to his *Will*, and in all things complying with the same, and embracing whatsoever happens to us, as that which from all *Eternity* was Decreed concerning us. Wherefore let our Modern *Upstarts* take heed, that they do not too curiously search into the *Nature, Decrees* and *Government* of GOD: But rather entirely persuade themselves, that he is most intimately acquainted with what is most Expedient for us; and that it is impossible, but that he who Loves all things, Does all things, Perfects all things, and Contains all things, should not always do the best of all in all Cases whatsoever.

XIV.
And in
Publick
places.

Neither is it sufficient for us, to offer *Innocent* and *Holy Hearts* to GOD, and to pray unto him in the secret Retreats thereof; but it is moreover required, that we pay him our *Devotions* openly, and in Publick places. For who is there that believes GOD, and can be ashamed to pray unto him, to praise him, and to offer Himself, and all his Powers and Faculties, for a whole *Burnt-Offering* unto him? Fear or Shame in this case, is a mark of *Degenerate Souls*; neither can he be said truly to worship GOD, who is ashamed to render him the *Veneration* that is due to him, and openly to profess, what in the most inmost Recess of his Heart he owns and adores. And on the contrary, when in the Churches and Publick places of worship, we render him the Glory that is due to his *Divine Majesty*; testify our *Devotion*, and are Zealous for his *Honour*; we by our Presence and Examples do also incite others to exhibit the like *Honour* and *Reverence* to him.

CHAP. XXIV.

Of the Duties of Man towards himself.

I.
The First
Duty is,
That he be
a good
Member
of the
Society.

MAN being most dear unto himself, and having his *Eyes* fix'd upon his own Good and Welfare, as the Center from whence all his Operations flow, and to which they return: It seems altogether superfluous to prescribe *Laws* unto him, to take care of himself, procure his own good, and advance his own interest. But forasmuch

as man was not born for himself only, but made by GOD for the good of *Human Society*, he ought so to behave himself as to be a fit Member of the *Body Politick*, and that as far as his state and condition permits, he be of use and service to the same. For no body is exempt from this *Law*; for how dull and stupid soever a man may be, and unfit for *business*, yet he makes himself obnoxious to the *Laws*, when he is not serviceable to the Community by some Art, Employment or otherwise. Every one must take care therefore that he be furnish'd with *Vertue*, Good *Manners*, and a sense of what is Good and Right: for as the *Soul* excels the *Body* in Dignity, and commands the whole man; so great care is to be taken in the improvement of it, to the end the *Body* may be obedient to its conduct, and perform its motions according to the *Rules of Reason*: wherefore every one is bound according to his *fortune* and natural gifts, to betake himself to some *Profession, Art* or *Science*, and choose to himself such a way of *living*, that he may not for the future, be burthen some to himself or others, or a useless member of the *Society* he belongs to.

And as we are to take care to furnish our *Minds* with *Arts* and *Learning*, so we are to bind our *Body* to its good Behaviour, lest being pamper'd it become unruly, and prove refractory to its Lord and Master the *Soul*. Accordingly we must take heed to feed it with necessary food only, and exercise it with labour, lest by intemperance in eating or drinking it run headlong into filthy Lust; and being dull'd and stupified by Idleness and inactivity, it become a clog and dungeon to the *Mind*. And forasmuch as the *Passions* do arise from the conjunction of the *Soul* and *Body*, and derive their force and strength from that unequal *Society*, all diligence must be used for the restraining and moderating the same, and timely quelling their first motions. For the *Passions* are like *Souldiers* that attack a place, who except they be beaten off at their first coming on, easily make themselves Masters of the Place, and take Prisoners, or cut down all they find in it.

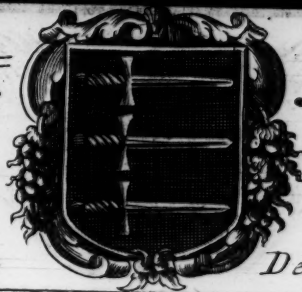
Yet it is not lawful for any man to lay violent hands upon himself, to be delivered from the violence of his *Passions*, or from those *Evils* that are incident to the *Body*. For he sins against *Nature*, who being impatient of the *Evils* he groans under, cuts off the Thread of his *Life*, and because he cannot live as he would, will not live at all. Man must remember that he is appointed by God to be, as it were, the *Guardian* of his own *Life*, not the *Executioner* or *Tormentor* of it; to whom he proves faithless, when-ever he treacherously surrenders himself to the Calamity that assaults him, which he ought courageously to resist and overcome; or else at the apprehension of shame or danger, or being wearied out with pain or trouble, puts an end to his *Life*. For by this *Despair*, not only GOD is offended by the destruction of his *Workmanship*, but the *Commonwealth* suffers also by the loss of one of her *Members*. And therefore it is that the *Laws* take up Arms against these their profest Enemies, and order them to be cast out without *Burial*, forbid any Pious Remembrance to be made of them; and if they fail'd in their design of dispatching themselves, brand them with

II.
How our
Body is to
be Governed.

III.
It is not
lawful for
a Man to
kill him-
self.



To the Worship=
Raulins of
Hereford



full Thomas
Kilreeg in
shire Esq.

This Plate is humbly

Dedicated by Richard Blome.



To the Right Worship-
 Cossine of Brafferton
 Rideing of Yorke shire
 of the Right Revernd
 Cossine late Lord

This Plate is humbly



full S. Gilbert Gerard
 hall in the North
 Baronet. Grand son
 Father in God John
 Bishop of Durham.

Dedicated by Richard Blome.

with a mark of perpetual *Infamy*. VALERIUS MAXIMUS tells us, that it was a Custom amongst the *Athenians* to make those who were sentenced to death to drink *Poison*, which afterwards was for good reason abrogated, for that it seems to be an unbecoming and unnatural thing, that a *man*, who above all things loves himself, should be made to hasten his own *death*, and contrary to the natural *Law* of self-preservation, should prove his own *Executioner*. We are to wait therefore till he who hath placed us in the *Post* where we are, do call us away, and dismiss us from the *Theatre* of the *World*.

IV.
A man is bound to resist him that sets upon him.

Man therefore being bound to preserve himself, it follows that he ought to defend himself from the Assaults of an *Aggressor*, and to repel his force by force, if there be no other way left for him to avoid it, or to flee from the danger. For tho' by killing of our *Enemy*, the *Commonwealth* suffers loss, and the same as if he who defends himself were killed; and that every man is bound to procure the common Good, Safety and Prosperity of the *Commonwealth*, and of every one of the *Members* thereof; yet this is only supposing that his *person* be not endanger'd thereby. For no *Law* can oblige us to betray our own safety, and conspire our own *Ruin*, to save a wicked person. Yea, every one hath a natural and inborn right, to stave off any violence done unto him, with all his might. For if it were otherwise, who could be said to be the *Possessor* of any thing he had, if it were lawful for *Robbers* to deprive him thereof, without his daring to oppose them, and to rescue his *goods* out of their *hands*? For what is it else to prohibit a mans defending of himself and his own *Goods*, but to drive *Justice* out of the *World*, and to bestow upon *Thieves* and *Robbers* that which is the property of other men?

V.
That we ought to spare even the Life of our Enemy

Yet must not we in this just defence of our selves endeavour to take away the *Life* of our *Enemy*, if there be any other way for us to avoid his fury; as for Example, by hindring his access to us, by getting into a safe place, or by exhorting our *Enemy* to desist from his intended Cruelty.

VI.
Especially if he repents and cries Pardon.

And if it happen that the *Aggressor* do repent of the *Injury* he hath done us, begs our *Pardon*, and promiseth to make amends for the hurt he hath given us; in this case, he that is affronted or set upon, ought to be reconciled to him, and leave all thoughts of *Revenge*. For his Repentance shews him to be changed, and that he is no longer an *Enemy*: And the very *Law* of *Nature* commands us to forgive the past faults of those who repent that ever they have affronted or offended us, and who ask *Pardon* for it. Except it should be made manifest that this *Repentance* was only the effect of force, and that the Offender did not desire *Pardon*, and to be reconciled, but only because his *Arms* or his strength fail'd him: For in this case, we ought to lay hold of him, lest recovering his strength he should set upon us unawares.

VII.
How he is to behave himself who lives under a Magistrate.

He who is obnoxious to the *Laws*, may lawfully be made an Example, whensoever time or place will permit a man to have recourse to his Superior, for his *safeguard* and protection against the violence and assaults of his *Enemy*. Hence it is that *Thieves* and *Robbers* are lawfully kill'd, ne-

cessity putting *Arms* in our *Hands* to defend our selves, and what belongs to us. But where we can have recourse to the *Magistrate*, we are to bring them before him, that offer us any violence or injury; it being only for want of this, that we may make use of the Right which the *Law* of *Nature* gives us, and by repelling force with force, take away the *Life* of the *Aggressor*.

As we may kill a violent *Aggressor*, so likewise do the *Laws* of *Nature* permit us to kill a *Thief*, that endeavours to rob us of our *Goods*. For these external things are the means whereby our *Lives* are maintained, and in the preservation whereof our *State* and *Honour* depends. Hence *Lawyers* call these outward Good things the *Life* and *Blood* of *Men*, which may be defended at the hazard of another mans *Life*, as well as *Life* it self. And tho' in *Cities* sometimes the thing stolen may be recovered by the help of the *Magistrate*, yet no man is bound to suffer the taking away of his *Goods*, because he may probably afterwards recover them; forasmuch as he hath not only a right to recover them when stolen from him, but also to preserve and keep them from the violence of others. And if this be so, that a man may defend his *Goods* at the peril of the *Aggressor*, I see no reason why a *Woman*, whose Chastity is attempted, may not kill the *Ravisher*; seeing a *Vertuous Woman* hath nothing that is dearer to her in this *World*, than her *Honour* and *Chastity*, and that no greater loss can happen to her, than to be by force deprived of the same.

VIII.
Thieves may be lawfully killed.

CHAP. XXV.

Of the Laws we are to observe with respect to other Men.

THE whole Duty of a *Man* is contained in behaving himself Reverently towards *GOD*, Prudently towards Himself, and Justly towards his Neighbour. The two foregoing parts of Mans Duty we have already spoken to, and now proceed to the last. The Duty therefore of a *Man* towards others, First of all consists in this, that he observe an Equality, and do not prefer himself before others. Secondly, That he hurt no man. For the peculiar *Law* of *Man*, as he is a Reasonable Creature, according to JUSTINIAN § Instit. de Just. & Jur. is reduced to these three Precepts, To live Honestly, not to hurt another, and to give to every one his Right. Now he gives to every man his Right, that doth not prefer himself to any; but being mindful of his Human Condition, embraces all with an equal Love in the like Circumstances. For tho' a man excel others in *Vertue*, exceed them in bodily Strength, be above them in gifts and endowments of *Mind*, and do more abound with *Goods* of *Fortune*; yet is he for all this never a whit the less bound to observe the *Laws* of *Nature*, nor hath he therefore any more Right to hurt others, than they have to injure him. For as *Nature* is benign and kind to all, and equally dispenseth to all the desire of *Truth* and *Right*; so likewise there ought to be an equal *Charity* maintain'd amongst men, and the same common Offices of Good-will one to another. For there is nothing more conducive to the preserving of a *Sociable Life*, than for men to do by others,

I.
The Duty of Man towards others consists in two things.

F f f f

as they would have others do by them; and for them not to expect or require any thing from others, but what they would as willingly, that others should demand of them.

II.
Equality is
to be pre-
ferred a-
mongst all
Men.

In order to the putting of this Equality in practice, it will be very conducive well to weigh and consider our Nature and Original, viz. that we were all formed out of the dust or mould of the Earth, and came all of us into the World after one and the same manner; and that being nourish'd by the same Aliments, we after some years arrive at Old Age, and at last all of us alike submit to Death.

III.
We are to
return one
good turn
for another.

This Equality amongst men thus supposed, it follows, that if we desire the helping hand of others, and their assistance in any of our affairs, we must be every whit as ready to lend them ours, and to procure their good and advantage. For he would be unjust, that should make use of another's help for the promoting of his own Interest, and looking upon it as his due, should not be ready to do the same service to the party that had obliged him by his assistance. Wherefore as they take most care for the good and advantage of the Society, who do not allow themselves any more than they would gladly allow to another: so that person ought to be lookt upon as an overturner of the Society, who affects a superiority, and expects honour or Service from others, and in the mean time disdains to return the same again to them. Hence by the Law of Nations this Permutation or Exchange hath been introduced, whereby I willingly grant unto thee the thing thou dost demand of me, upon condition, that thou in like manner do grant unto me, another thing I ask of thee, having first made a tacit estimate of the value of both things with our selves.

IV.
No Man
hath Right
to prefer
himself be-
fore ano-
ther.

Those are defective in the performance of this Duty, who, because of their Riches would be preferred before others; and despising the Equality whereby Nature hath level'd all of us, and set us upon even ground, do conceit a vast distance betwixt themselves and others: whereas it would be much more becoming them to call to mind the manifold weaknesses incident to human nature; the Errors and faults they have formerly committed, and are still obnoxious to; the Passions that dominate over them, and to whose motions they are as much enslaved, if not more, than others. Moreover, forasmuch as there is nothing Praise-worthy in man, save only what proceeds from his Free Will, there is no reason why any one should prefer himself before another, since they may as duly make use of their Reason, and with equal constancy continue in the purpose of doing those things which Reason persuades and recommends to them. For in this firm purpose doth the very Essence of Vertue consist, and which may be found as well in a Commoner as in a Prince, in a Poor Beggar as in a Rich Man. Nothing more becomes a man of a generous temper, than virtuous Humility, which consists in this, that a man seriously consider Human frailty and weakness, which he finds in himself as much as in others.

V.
No Body is
to be despi-
sed or flout-
ed at by
outward

But their fault is yet more gross and inexcusable, who undervalue and trample upon others, not only by inward disesteem and contempt, but also by some outward signs, as by Words, Looks, Laughter, do flout at and vilify others. Which

offence is the more criminal, forasmuch as this behaviour is exceeding provoking, making the party so derided to be inflamed with Anger, and to be strongly moved to seek for Revenge. For so impatient is the Mind of Man of Affronts, that many are not afraid to hazard their Lives to revenge them, and will rather violate a long continued Bond of Friendship, than to bear an open and petulant abuse. For a Mans Reputation and Good Name is wounded thereby; as we find daily, that he is oft undervalued by others, who suffers himself tamely and cheaply to be abused.

Another Duty every man is to practise towards his Neighbour, is to hurt no Body. For it is the Law of Nature, 206 F. de Regul. Jur. That no Man make himself Rich at anothers Cost. The Equity of this Precept may be gathered from the consideration of Man, both as he is a Singular Person, and as he is a Member of the Commonwealth. For as it is contrary to Heat, to be the cause of Cold; and to Moisture to cause Driness; so it is contrary to the Nature of a Just Man, to offend his Equal, or to provoke him by doing any hurt or injury. Thus DEMONAX, the Philosopher in Lucian, boasts himself, that he never went to Law, never was troublesome to any, but always was a Friend to all, and an Enemy to none. In like manner it is also the property of a Good Man not to hurt any. For Nature hath ordained a kind of Alliance and Consanguinity between Men; whence it is criminal and highly unjust for a Man to lie in wait for another, to betray or cheat him, or to invade what belongs to his Neighbour; because by this means the Communion between Mankind is dissolved, as the soundness and healthful state of the Body is overthrown, when a stronger part attracts the sustenance that belongs to all the rest to its self, and instead of only taking its due, usurps that which appertains to the whole Body.

When it is said that we are not to do any harm or damage to any: By the word Damage is to be understood, whatsoever may cause any detriment or inconvenience to any one; such as are the Taking away of what belongs to another, Depravation, Diminution, intercepting of the Rent or Income proceeding or hoped from any thing. Because it is not only the Possession of things that is rated or valued at a Price, but also the future perception of the Rents and Incomes of it, in case they are surely to come to our Hands. Wherefore every one that harms another, either in his Goods, or in his Good Name, is bound to make Reparation of the Damage he hath done to his Neighbour. For a Good Name is the greatest of all outward Good things; which being once lost, all other Enjoyments are lost together with it. Now a Man may damage another, either by himself, or by the help and assistance of others: but which way soever it be done, it is always imputed to him that is the Agent, and he is bound to make Reparation for it. Because it is agreeable to Reason, that he that hath done the Hurt, should make amends for it, and make good the Damage he hath been the cause of, tho' he did it by another; for he that does any thing by the ministry or help of another, does the same as if he acted it himself. But if many persons do equally concur to the doing of any Harm or Damage, they are all of them bound to make good

marks of
contempt or
derision.

VI.
No Man
must be
hurt by us.

VII.
What
Harm or
Damage it,
and how it
must be
made good.

CHAP. XXVI.

Of the Laws of Mutual Humanity.

good the same, according to their several Degrees of concurrence to it. In like manner he who by his Counsel, or Advice incites another to a *Crime*, or gives him the occasion of committing it, that himself may get profit by it, is bound to restore whatsoever damage or hurt this means may happen to the party offended. But the case is not the same with respect to him, who hath only given occasion to the doing of a *thing*, or assisted the Delinquents with his Counsel, without any advantage thereby accruing to himself.

Neither is he only bound to make good the Damage done to his Neighbour, who by falseness and design hath harmed another, but also who by his Carelessness or Laziness hath suffered this harm to come to him. For it is necessary in order to the preserving of *Human Society*, that every one do carry himself with such Caution, that he may be useful to the *Society*, and that he may not by his Idleness be a Burthen to any. He who by chance, and without set purpose doth hurt another, as when a *Man Fighting* among the thickest of his Enemies, doth by chance wound his Fellow Souldier that stands near him, without any such intent, or knowing him to be so, cannot be compell'd to the making good of the hurt he hath done him. For seeing that the fault was committed without his Will or consent, therefore neither can it be imputed to him; for there seems to be no sufficient reason, why he who hath committed a fault against his Will should be lyable to be amerced, rather or more than he who is Wounded.

Neither are we only obliged to repair the Damage we our selves have done to others, but also that which hath been caused by our Servants, Cattle or other Living Creatures. For seeing that Servants are parts of the *Commonwealth*, they are bound to the same Laws as their Masters are; and whereas they possess nothing whereby they might be in a condition, to make good the hurt they have done; it is but just that their Masters should be bound to repair it, or else to deliver them into the Hands of those whom they have injur'd. For otherwise a *Servant*, especially a *Slave*, would be at *Liberty* to hurt whom he pleased, if no reparation were to be had neither of him, nor of his Lord and Master. And the same may be said of our Cattle, or other Living Creatures that belong to us, as when our Cattle Trespass upon other Mens Ground, or when they chance to Kill or Wound any Man. For seeing that the owner of any Living Creatures, makes use of them for his own profit, and that they are gainful to him, it is but just that Reparation be required of him, if he hath a mind to keep them still; or if so be that he doth not value the said Creatures so high as the damage is rated, that then they be Killed. It is fitting that he who knowingly hath done any prejudice to his Neighbour, do freely offer Reparation to him, lest his Neighbour being offended and provoked, should think of returning like for like: So in like manner he who hath received the injury, ought to wink at it, and be ready to be reconciled with him that hurt him. He who doth otherwise violates the Laws of the *Society*, and breaks that Peace which is the Foundation and support of the *Commonwealth*.

Good-will is a *Quality*, that is inborn in the Minds of all Men; so that he seems to have shaken hands with *Humanity*, who is not ready to do good turns to his Neighbour. For it is a *Law of Nature*, that every one should bear Good-will towards others of his own kind, and, as far as his condition and circumstances will permit, endeavour to procure their Good. For since Nature hath made an Affinity and Kindred between all Mankind, joyning them together in a Brotherly Band, it is not enough for them that they do not hurt one another; but it is over and above necessary, that they assist and succour each other. Now Men become useful to others, either in their own persons, or by imparting such Conveniences or good things to them, as are beneficial and advantageous to them.

By our selves, or in our own persons we become useful to others, when from our very Child-hood we are educated in good Manners and Literature, and acquire those Accomplishments of Body and Mind, the fruits whereof may afterwards redound to the good of others, and our Actions procure Honour or advantage to the *Commonwealth*. And therefore they are injurious to *Human Society*, who lead a lazy and slothful Life, and indulging their Body only, consider none but themselves: And who with the Riches they have got, or inherited do Fat themselves like Hogs, minding nothing else, but to Live as long as they can, and to Glut themselves with Pleasure, and wallow in all manner of Luxury.

But they who lay out themselves for the Service, Honour and Advantage of the *Commonwealth*, ought to be had in high esteem by all the Members of it, whose Duty it is to promote as far as in them lies, all their good endeavours, and to take heed lest being moved by Envy, they despise the things they understand not, or which they themselves despair of attaining to. For what can be imagined more unjust, than to think ill of them, who are of use to their Country, and to hate those who lay out themselves in doing good to others, and make it their Business to promote the publick Good?

The things that we may bestow upon others are, such especially as we can part with, without any damage or prejudice to our selves, but are of great advantage to the Receiver. And accordingly the Law saith, whatsoever is of advantage to me, and is not at all hurtful to thee, the same it is not fitting that thou shouldst hinder me of; for this is the Dictate of Equity, tho' it be no due of Justice. It is a piece of a Malicious Nature in any one, to forbid others to draw Water at his Well standing by the way side; or to envy others that are in darkness to enjoy the light of his Candle; or who will not permit his Neighbour to kindle a stick of Wood in his Fire; forasmuch as all this may be done without diminishing of the Water in the Fountain, the Light in the Candle, or the Fire on the Hearth. Wherefore, when any one undervalues the possession of any thing belongs to him, and intends to make no further use of it, it is not only inhuman, but unjust to deny the same to another, and rather suffer it to be spoiled,

I.
Every one is bound to be helpful to his Neighbour.

II.
Who are useful, and who useless to the Commonwealth.

III.
Who are to be honoured in a Commonwealth.

IV.
We are free to give those things, the bestowing whereof is no detriment.

VIII.
Whoever by his Negligence is the cause of the spoiling of any thing, is bound to make it Good.

IX.
Masters are bound to make Good the Damage or Hurt done by their Servants.

spoiled, than that it should be of use and advantage to others. Wherefore according to the *Law of Nature*, tho' outward *Laws* be silent, all things that are of no use, belong to the *Poor*, and *Rich-men* are bound at the least, to bestow all those things on the *Poor* and *Needy* which they leave off, as likewise the superfluous *Meat* of their *Tables*.

V.
We must be
Noble and
Generous in
the Relie-
ving of our
Neighbour.

But forasmuch as this last mentioned, is the least piece of *Humanity* we can express to others, they act more generously, and shew themselves more to be *Men*, who are ready to do good to others, tho' with some detriment or prejudice to themselves. Only we must take care, that these our *Charitable Offices*, be not hurtful to those who receive them, and instead of being beneficial to them prove their Bane. Thus it is with good reason, that we refuse putting *Arms* into a *Madmans Hands*, deny one that is Sick of a *Dropsy* cold *Water*, are importunately troublesome to one that is Sick of a *Lethargy* to hinder him from *Sleep*, and keep *Money* from him, who we know will go and throw it away at *Dice*. Because in the bestowing of *Benefits*, we are not so much to mind the *Will* of those who desire them, as of what use and advantage they will be to them.

VI.
Gifts or
Benefits are
to be be-
stow'd free-
ly.

In our bestowings of *Benefits*, there must be no hope of receiving the like in lieu thereof; because *Virtuous Actions* carry their *Reward* along with them, and therefore are to be practised without any respect of gain, or advantage to be reaped from them. Thus we give to *Poor Seamen*, that have been *Shipwrackt*, whose *Faces* we shall never see again, and relieve and succour the miserable, meerly because they are so, and because it is a *Duty* of *Humanity* incumbent upon us, to take *Pity* on the *Calamitous* and *Miserable*. By the same motive, we sometimes bestow our *Benefits* secretly, without making our selves known to those whom we relieve, to comply with their *Shamefacedness*, and that they may rather seem to find it, than to receive it.

VII.
The Duties
of those
who receive
Favours or
Benefits
from others.

In the receiving of *Benefits* it is required, that we be thankfully affected towards our *Benefactors*, and express our acknowledgment to them, and how ready we shall be upon occasion to return their kindness with advantage. Not as if it were necessary, that our return should be always of the same value, and estimate with the benefit received, for in many cases it is sufficient if only with a sincere *Will*, and grateful *Mind*, we acknowledge our *Obligation*, and are ready to make a return, tho' it may not be in our power to do it. Tho' indeed where *Men* are able, it is better to express their *Gratitude*, by returning the like good *Offices* and *Benefits*, besides the testifying of our thanks by words. For the great use of *Benefits*, is to beget a nearer Union and Love amongst *Men*, and to be an occasion for the exercising of *Benevolence* and *Liberality*. But if any one is unwilling to be engaged to another, he may refuse the offered kindness, or at least so handsomely decline it, as that he that offers it, may not take it ill, that his Good-will or Kindness is slighted.

VIII.
There is no
Vice more
abomina-
ble than is
that of In-
gratitude.

A *Man* cannot be guilty of a more shameful Vice, than that of *Ingratitude*; insomuch that there are no *Nations* so Barbarous, no *Manners* so Savage, but do condemn and detest it. For tho' an unthankful person be not injurious to another,

yet is he no less infamous than a *Thief*, a *Murderer*, or a *Traitor*; seeing that the very *Wild Beasts* themselves, when engaged by our care and kindness, are not wanting to express their thankfulness, not only in acknowledging it by their gestures, but often by defending their *Benefactors* in time of danger. And accordingly the *Law of Nature* ordains, that we never receive any *Benefit*, but with such an inward *Disposition*, that the *Benefactor* may never have any occasion to repent himself of having bestowed it upon us. The reason of which *Law* is, because if we receive a *Benefit* with a *Disposition* contrary to this, there will be no more Kindness to be found amongst *Men*, and all Amicableness will be banisht from amongst them.

But you'll say, if the abominableness of this Crime be such, why are not ungrateful *Men* impleaded, and why may not an *Action* be had against them?

To which I answer that the reason is plain, because a *Benefit* is a free *Gift*, and being a *Virtuous Action* must not be omitted, because of the unthankfulness of the *Receiver*. Besides, *Gratitude* cannot be looked upon as a strict due, because it was not agreed upon contract, tho' there might be some hope of it. Moreover, if an *Action* might be had against an ungrateful *Man*, seeing there be so many of them in the *World*, all *Courts* of *Justice* would not be sufficient to hear or determine them, and the rather because of the manifold Circumstances which alter the *Benefit*, and encrease or diminish it.

CHAP. XXVII.

Of the Laws that are to be observed in Covenants and Contracts.

BY the word *Covenant* is meant the Consent, or Agreement of 2 or more to the same thing. And it takes its original from hence, because there are many *Benefits* and Good turns, to the Performance whereof we are obliged by the *Laws of Humanity*, which yet cannot be exercised without some Injury to our selves, and therefore it was necessary, that *Covenants* should be entered into, by which every one might demand his own, or require and expect what is anothers, but without his Damage or Prejudice.

It is required in all *Covenants*, that they who enter into them, stand to the Agreements they have made and consented to, and inviolably observe what they have promised. For otherwise, there would be an end of *Human Society*, *Friendship* would be banisht out of the *World*, and miserable *Men* would have no Refuge, whither to betake themselves in their *Calamity*. For what would become of all the good Offices of *Humanity*, and the freedom that is between *Friends*, if *Promises* should be broken, and *Mens Actions* should not agree with their *Words*? Besides, where *Men* are not as good as their *Words*, endless matter is turnisht for *Dissensions*, *Quarrels* and *Contentes*, because we cannot break our *Words*, without being *Injurious* to the other party concerned. And accordingly the *Law* hath so ordered it, that *Men* may be forc'd to perform their *Covenants*, and to pay what by their *Promise* they are obliged to.

We

art



To Francis
Citty of London



Forbes of the
Gentleman

This Plate is humble

Dedicated by Richard Blome



THE PRINCE OF MONTE
AND THE PRINCESS OF MONTE
AND THE PRINCESS OF MONTE
AND THE PRINCESS OF MONTE

III.
What a
Promise is.

We Oblige or Bind our selves 2 several ways, viz. by Promise and Covenant. A Promise is the Willing or Spontaneous Obligation of a single person to perform something; whereas a Compact or Covenant, is that whereby 2 or more do oblige themselves, to do something or other. A Promise may be divided into a Complete, or Incomplete Promise. We call that a Complete Promise, when he who promiseth any thing to another, is willing to be so far obliged, as to give him liberty to force him to perform his Promise. An Incomplete Promise, is that whereby a Man promiseth to perform something, yet without giving the other any Right to compel him to the performance of it. So that they who thus engage themselves to do any thing, are not so much bound by the Laws of Justice, as by those of Veracity. Tho' indeed Generous and Vertuous persons, without any such annexed Obligation, are always ready to perform their Promises, choosing rather to suffer some inconvenience, than not to be as good as their Word.

IV.
Consent is
required to
a Promise.

It is requisite to the validity of a Complete Promise, that the pleading of ones word be Deliberate and Spontaneous; for seeing that he who promiseth, may be forced to be as good as his Word; he is inexcusable if afterwards he should complain of it: Because it was in his Power either to agree to it, or to refuse his Consent. Now a Man is judged to have consented, not only by External Signs, as by his Words, Handwriting, Nod, or other motions of his Body; but even by his Silence, if other Circumstances concur; because according to that common Saying, amongst the Lawyers, *He who is silent, seems to consent.*

V.
Who are in
a condition
to give
their consent.

To the end a Man may be in a condition to give his consent, it is required that he be in his right Wits, and in the use of his Reason, so as to be able to discern, whether the thing in Question be accomodate and fit for the end intended, and whether, what he agrees to can be performed by him. Hence it is, that the Covenants of Madmen and Fools, are looked upon as void and invalid; as also of Men in drink, if it be made appear that they were so far overcome by it, as not to be thoroughly sensible of what they did. For Consent supposeth a clearness of Perception; and he may rather be said to be seized or hurried away, than to consent or agree, who by a precipitant impulse, without consideration is driven to the doing of any thing. So that he would be looked upon as a Shameless and Unjust Man, who should go about to compel a Man to the standing to such alike Agreement, which at first was entred into by an invalid consent.

VI.
A mistake
invalidates
a Covenant.

As Reason asleep or overwhelmed makes void a Contract; so Error or Mistake doth weaken and invalidate it. For whosoever promiseth any thing to another upon condition, is not bound to keep his Word, in case the condition do not follow; because the want thereof makes void the Obligation. And if there be a Mistake in the thing, about which the Covenant is made, it thereby becomes invalid, not only because of the mistake that is found in it; but also because it is a contravention to the constitutions of Covenants and Agreements. For in order to the Selling, Letting, or Exchanging of any thing, it is necessary that the Buyer, &c. be fully acquainted with

the Condition and Qualities of the thing; forasmuch as without this knowledge, there can be no full consent; and accordingly he who is about to buy or hire a thing, if any faults therein be discovered, may break the Bargain, or force the other party to make good the defect, or allow a consideration for the Damage.

Covenants are also made invalid by Deceit or Malice, when a Man is Circumvented by some fraudulent trick, and drawn into Agreement. Therefore he who by Deceit is drawn in to Promise ought to another, is not bound to perform the same, except of his own Free-will, and without any fraudulent enticement he do agree to it; for then he is bound to stand to his Agreement, as long as there is no flaw in the thing, and that its true value be declared. For otherwise the Covenant becomes invalid, and it is in the power of him who finds himself agrieved, to break the Agreement, or to demand a Compensation of the Damage he sustains by it. But if another, who is not concern'd in the matter, about which the Agreement is made, do mingle any thing of Deceit with it, neither of the Parties agreed being partakers with him, then the Agreement stands firm notwithstanding. But so as it is in the power of him that suffers by it, to demand Reparation of the loss he sustains by his Malice.

Fear, as it doth not take away the freedom of the Will, as hath been said in the 20th Chapter of this part; so neither doth it dissolve Contracts. The suffering or punishment that is threatned by the Sovereign or Magistrate, if we will not consent to such an Agreement or Covenant, cannot invalidate the same, except they should go about by any unjust force to compel us to it; because in this case the Injury they do unto me by the unjust fear they cast me into, makes them incapable of having any Right over me. And seeing that the Damage caused by another, ought to be repassed by him, by way of Compensation, that Obligation is supposed to be taken away, if no satisfaction be made for the thing, which ought presently to have been restored.

As to the nature of the things that are agreed upon, or are promised, many things are required. First, that they be such as are in our Power; for otherwise it would be an Argument of Madness or Dishonesty, for a Man to Promise or Covenant that which is not in his power to perform. For no body is bound to perform Impossibilities, according to that common Rule, *There can be no Obligation to Impossibles.* For tho' at the first, when the Covenant was made the thing was possible, if afterwards by chance, without the fault or neglect of the party bound, it be made impossible, the Obligation is dissolved, and the Covenant becomes void.

Secondly, they must be things that are Lawful, for otherwise we cannot be obliged to the performance of them. For he that promiseth to give a Whore the meeting; or hath past his Word to Maim or Kill another, is not bound to keep his Oath or Promise. Because no Man can bind himself to any thing which it is not in his power to perform: Now the Laws have absolutely deprived him of any such power, nor will suffer him to execute that, which they plainly prohibit. So that if he be guilty, who promises that which the

G g g g

Law

VII.
Agreements
are made
void by
deceit and
falseness.

VIII.
Fear doth
not always
break con-
tracts.

IX. what
About
things A-
greements
may be
made.

X.
They must
be things
lawful or
permitted.

XI.
They must
be such as
we have a
Right to.

XII.
Promises
are made
two several
ways.

I.
What a
Contract is

II.
Of Con-
tracts No-
minate and
Innominate.

III.
Some are
Gratuitous,
others Bur-
thenfom.

Law forbids, he is doubly so, who having Promis'd such things, does stand to his word.

Thirdly, They must be *Our things*, that is, we must have a Right and Propriety to them; because we cannot Promise any thing which belongs to another. But in case we have Promis'd to take care, that what we have Promis'd shall be performed by another, over whom we have no *Command*; we are bound to use our utmost Diligence, and to omit nothing (as far as in a Civil way we can) that he may make good what we have so Promis'd.

A Promise may be made 2 several ways, either *Absolutely*, or *upon Condition*. Now a *Condition* may be 2 ways consider'd, either as *Possible* or *Impossible*. An *Impossible Condition* is either taken *Physically* or *Morally*. A Condition is *Physically Impossible*, when considering the Nature and Order of Things, the Matter cannot be done; and *Morally Impossible*, when they are forbidden by *Law*, or contrary to the Laws of *Honesty*. And these *Promises* are either made by *our selves*, or by some *Intervening Persons*; which we likewise are bound to perform, in case they have carried themselves honestly and faithfully, and have done nothing, but according to our Order.

CHAP. XXVIII.

Of Special Compacts or Agreements.

THO' a *Covenant* and *Contract* be often confounded by *Authors*, and include, as *ULPIANUS* saith, the *Consent* or *Agreement* of two or more *Persons*; yet to speak more exactly, a *Contract* seems chiefly to consist in an Interchangeable giving and receiving; or to be chiefly conversant about things of *Commerce*.

Of *Contracts*, some are called *Nominate*, as *Selling*, *Buying*, *Lending*, *Letting*, *Pawning*, &c. which have a particular Name whereby they are distinguish'd from others. Others *Innominate*, that have no particular Name belonging to them, but are only signified by the common Name of *Contracts*. And these are reducible to 4 kinds: I give that thou mayst give; I give that thou mayst do: I do that thou mayst give; and I do that thou mayst do. In all which *Contracts*, an *Action* is allowed in any Form of words, when a certain one cannot be assigned: For we find by Experience, that there is a greater plenty of *Business* or *Affairs*, than of *Words*.

Secondly, *Contracts* are divided into *Lucrative*, otherwise called *Gratuitous*, that is, such by which *Profit* accrues to one of the Parties concerned, without the Intervening of a *Merchandise* or *Price*: And *Burthenfom* or *Chargeable*, in which both Parties have an Equal burthen charg'd upon them, and in which there is a kind of *Recompensation*. For it is the property of all burthenfom and chargeable *Contracts*, that the Parties concern'd in it, have an equal Advantage by it, and undergo a like *Burthen*. Inasmuch as if it otherwise happen, the Party who finds himself frustrated, hath Right to demand what is wanting to him, or else to break the *Contract*. And accordingly, it is usual in well governed Cities, to have the prizes of every thing set and stated, to prevent all common Abuses in such cases.

Gratuitous, or *Lucrative Contracts*, are commonly reduc'd to these three; a *Loan*, a *Commission* or *Charge*, and a *Depositum* or *Trust*. A *Loan* is, when the use of a thing is granted to another, without any recompence therefore received or appointed. It is his concern who borrows any thing, that he be very careful of the thing that is Lent him, that it may not be put to any other use, than what is prescrib'd by the *Lender*; and accordingly is oblig'd to restore the same whole and sound; excepting so much only as it may be the worse for so long using. If the thing Lent, whilst it is yet in the custody of him that hath borrowed it, come to be lost or spoil'd, the Value of it must be restor'd by the *Borrower* to the *Owner*: But if it be of such a Nature, that it could not have been better kept, if it had been in the *Owners* keeping, the *Borrower* is not bound to make it good. Yea, if it so happen that the *Borrower* hath laid out any thing towards the mending or improvement of it, it is but just that the *Owner* should repay it, besides those *Expences* which always attend the ordinary use of any thing.

A *Charge* is, when a Man takes upon him to perform a *Commission* he is charg'd with, without any hope of *Reward*. And he who undertakes any such *Charge* at the Instance of another, or of his own accord, must take care to be punctual in performance thereof. For seeing that no Body trusts his Affairs, but with a Friend of whole *Faithfulness* he is assured, the *Undertaker* ought to be very Solicitous to shew himself an honest and true Man, and that in all things he answer the Expectation of his *Friend*, and the Confidence he puts in him. Now he who undertakes any *Command* or *Charge*, must be allow'd for all the *Expences* or *Damages* that may be in the Executing of the said *Commands*.

A *Trust* is a *Contract*, whereby something is entrusted with another to be kept. The Person with whom the thing is entrusted, is called the *Depositary*; who is to take great care, that the thing he is entrusted with, be not lost or spoil'd, and that he be always ready, at the Will of the *Depositor*, to restore it. Except it should be more for his Advantage to want it for some time, and that it be found better; because of some imminent Danger, to defer the restitution of it till a later date. But yet the *Depositary* may not make use of the same, except with the *Owners permission*; if either it be such a thing as grows the worse for using; or if it be the *Owners* Concern that it be hid, and be not exposed to the Sight of others.

The most Ancient of all *Chargeable Contracts*, and received by all Nations, is *Permutation* or *Exchange*, used before *Money* was Coyn'd, to be the indifferent Price of all things. The Formality whereof is prescrib'd \$. Item pretium de Empt. & Vendit: I willingly graunt you the thing you desire of me upon this Condition, that you likewise do graunt me another thing which I ask of you, according to the tacit Estimation of both the things made by our selves. Opposit to this *Contract* is *Donation*, whereby a thing without any Compulsion of the *Law*, and out of meer Benevolence and Good-will is bestowed upon another; forasmuch as it is not necessary that any Equality should be observed therein.

IV.
Gratuitous
or Lucra-
tive Con-
tracts are
Lending.

V.
A Charge
or Com-
mand.

VI.
A Pledge
or Trust.

VII.
Burthen-
fom or
Chargeable
Contracts,
are Per-
mutation.

To

VIII.
Buying and
Selling.

To *Permutation* belongs also *Buying* and *Selling*, whereby a thing is either purchased or let go for a *Price*: For by the former there lies an Obligation on the *Buyer*, to deliver the *Price* agreed on for the *Commodity*; as by the latter, the *Seller* is bound to let go the *Commodity* for the *Price*. Which is done many ways: As *First*, When there is a mutual *Agreement*, and the *Buyer* immediately offers his *Money*, and the *Seller* his *Merchandise*. *Secondly*, When tho' the *Merchandise* be immediately deliver'd, the *Price* is not to be paid till such a set time after. *Thirdly*, When after that the *Parties* are Agreed about the *price*, the *Merchandise* is not to be deliver'd till a certain Time. In which last *Contract*, it is consentaneous both to *Reason* and *Justice*, that if the thing should come to be lost or spoil'd before the prefixed time, the *Seller* should bear the loss of it. But if after that time expired, the *Buyer* neglect the taking of the *Commodity*, if any damage happen to it, it must be at his Loss.

IX.
Lending
and Hiring

Lending and *Hiring*, are near of Kin to *Buying* and *Selling*, whereby, for an appointed *Price*, the use or worth of a thing is granted. I said, for an appointed *Price*: For if (saith JUSTINIAN, *Inst. l. 3. Titul. 25.*) I give a *Fuller* Cloth to be dressed, or to a *Botcher* Cloaths to be mended, without the appointment of a Set price; but only that afterwards I shall give as much as shall be agreed upon between us; this *Contract* cannot be called *Lending* or *Hiring*, but allows an *Action* set down in a precise Form of *Words*.

X.
What is to
be observ'd
in Hiring.

About this *Contract* it is to be observed, that if in the Time of *Hiring* the thing be spoiled or perish, he who hires it, is not bound to pay the *Price* of it. In like manner, when a thing design'd to a certain use, which the *Owner* is bound to deliver safe and sound, does chance to suffer any loss or detriment, whereby it is made less proper for the use it is appropriated to: He who *Hires* it, may with Justice detract so much from the *Price* of it, as it is become less fit for its intended use; tho' this cannot be where the increase or income of the thing is uncertain. As for Example, If a Man have hired a *Field*, whose *Fruits* have been spoiled by the Unseasonableness of the *Weather*; he is bound notwithstanding to pay the *Hire* he hath agreed for, tho' the Income he has from it, for that *Year*, be little or nothing: For as a plentiful Income doth not increase the *Hire*, neither doth it seem Equal, that a scarce Increase should diminish it; since it frequently happens, that one *Years* Barrenness, is compensated by the Fruitfulness of the next following.

XI.
Things
lent.

Lending is a *Contract*, whereby a Man delivers something of his *Goods* to another, upon Condition that he, after some Space of Time, do restore to him as much of the same kind and goodness. *Things lent*, are such as are spent or consumed by using, and do consist in Number, as *Money*; in Weight, as *Gold*, *Silver*, &c. in Measure, as *Wine*, *Oil*, &c. The Gospel Law Commands us to lend, without expecting any Gain or Advantage to ourselves there from: Which Law is transgressed by the *Usurer*, who tho' he be bound to relieve the Wants of his *Neighbour*, doth by *Usury* gain thereby, and enriches himself out of the miserable Remains of *Shipwrack*, by an unnatural Cruelty to those of his own kind. I am not ignorant of the Dis-

inction the *Lawyers* make here, of the *Ceasing* Gain and *Emergent* Damage. And indeed his Case is different, who lends *Money* to one that desires it, not to deliver himself from his present Necessities, but that he may Negotiate therewith, and make a great advance of Gain to himself from the *Money* he hath borrowed; and of him, who being shut up in a *Prison*, and miserably Poor and oppressed by a Cruel *Creditor*, desires to borrow a Sum of *Money*: For in this case, what he desires ought either to be given to him freely, out of Pity to his Condition, or at least be lent to him, without demand of Use for it.

There is also another sort of *Contract*, which is called a *Society Contract*, or a *Partnership*, and is the Agreement of 2 or more *Persons*, whereby something proper to make Gain with (as *Money*, *Work*, *Industry*) is contributed in order to a Common Use or Advantage. Now, to the end that such a *Society* or *Partnership* may be Just, 3 things chiefly are required: *First*, That the *Trade* or *Dealing* they intend be Just and Lawful; for no Man can be bound to that which is Unlawful. *Secondly*, That their Shares in *Gain* and *Loss*, be equally proportion'd to the Shares of the *Stock* laid in by the several *Members* of the *Partnership*; so as that his *Gain* may be greater that hath a greater Share in the *Stock*, as his loss that hath a less, because by this means every ones Due is given to him. *Thirdly*, That the Loss in like manner be Common, and be equally divided amongst the *Partners*; tho' sometimes the *Contract* be so, that one contributes *Money*, and another his *Work* or *Labour* only; which frequently is Equivalent to *Money*. Wherefore the Original *Contract* is to be heeded, and how the *Parties* are agreed about their Shares of *Loss* and *Gain*.

XII.
The Con-
ditions of
the Con-
tract of
a Society.

C H A P. XXIX.

How many ways the Obligation, arising from Covenants, may be dissolved.

Seeing that *Obligation* is a kind of Tye or Engagement laid upon us by Law, whereby, as JUSTINIAN saith, We are of Necessity bound to pay something, according to the Laws of the *Society* we live in, the same is readily and Naturally taken away by paying or satisfying of the same. For thereby the *Duties* thence arising cease, as also the *Action* whereby a Man before was Bound. To the end this *Payment* may be duly made, it is not necessary that it be done by the *Debtor* himself, but it is sufficient if it be done by another, in his Name. For a *Debtor* is quitted of his *Obligation*, if the *Money* be paid by another, tho' without the Knowledge, and contrary to the Will of the *Debtor*. Neither is it necessary always to pay the *Debt* to the *Creditor*; but it is sufficient if it be paid to any one appointed by him.

I.
How Obli-
gation may
be taken
away, by
Solution or
Payment.

Secondly, An *Obligation* is dissolved by *Donation*, that is, by *Remission*, or Forgiving of the *Debt*; which is commonly done either by *Acceptation* or *Imaginary Payment*, with the use of some Signs intimating a Consent or Agreement, which of old was in use amongst the *Greeks*; the *Debtor* speaking these Words, *You have received so much Money*: To which the *Creditor* delivering his *Bond* or *Note*, answer'd, *I have received them*.

II.
By Dona-
tion.

Thirdly,

III.
By Com-
pensation.

Thirdly, Obligations are taken away by Compensation; as when the Creditor by a former Engagement was a Debtor to his Debtor, owing him something of the same kind and value. For in things deliver'd for use, an Equivalent is reckon'd as the same thing. Hence it is, that in Actions at Law of this kind, Compensation was always allow'd of; viz. an Exception, whereby any Man rids himself of his Creditor, by shewing that he is his Debtor; for a Debt is Compensated with a Debt, Fraud with Fraud, and a Fault with a Fault, and this very very justly too, saith the Law; for we are rather not to pay, than to demand what we have paid.

IV.
By a con-
trary Will.

In the Fourth place, Obligations that are entred into by Consent or Agreement, are dissolved by a contrary Will: For suppose TITUS and SEJUS have agreed together, that SEJUS should have a piece of Ground for 100 Pieces of Gold; and that before the Money be paid down, or the Land delivered, they should agree together to break their Contract; it is evident, that by this means that Contract would be dissolved. And this is common to all Contracts, which are made and ratified by Agreement and Consent, especially that of Partnership, which continues only so long as the Parties abide in the same Mind.

V.
By the in-
tervening
of a New
Agreement

Obligations also are dissolved by the Intervening of a New Obligation, as if the Debt which John owes me, should by Agreement be made payable to me by Paul; because this intervening of a new Person, makes a new Obligation to take place, and annuls the former. Neither is it necessary, that this latter Agreement be advantageous; for tho' it were quite otherwise, yet would it notwithstanding make void the former.

VI.
By urgent
Necessity

An Obligation is likewise made void by urgent Necessity; and therefore a Debtor that is reduc'd to extream Want, is not bound to pay his Creditor, tho labouring under the same Extremity of Want; because in Extream Necessity all things are common, and the Condition of him who is in Possession is accounted the better of the two.

VII.
By breach
of Word
or Articles

He that breaks his Promise, and doth not perform his Articles, doth rather break off the Obligation, than make it to cease. For seeing that all Contracts are mutual, and that the Parties are equally bound to perform what they have agreed to, when one breaks his word, there is an end of the Contract: For the Pledging of our Faithfulness, supposeth the Faithfulness of the other party, and is as a Condition in reference to the other. I shall perform what you require of me, if you do first what I require of you; and I will stand to my Promise, as long as you inviolably observe the Agreement we have made.

VIII.
By Death.

Lastly, An Obligation is annull'd by Death, and any Contract ceaseth, when it rests only upon one Person, whereas the Agreement was made by two. For where the Subject is destroy'd, the Accidents which do attend it, must of needs perish likewise. Except that the Heir of the deceased Party, of his own inclination, or out of his respect to the Deceased, do take upon him to satisfy the said Obligation: Or, if by the Last Will of the Dead, he be bound to pay the Debts of the Deceased out of his Estate, and that he is made his Heir upon that Condition.

CHAP. XXX.

Of the Laws that concern Speaking and Swearing.

Forasmuch as Covenants and Contracts are performed by Words, and that it is necessary for the maintaining of Human Society, that mens Minds be made known by Speech, we shall add something here concerning the Duties to be observed in Speaking in general, and afterwards of those that are to be heeded in Swearing. The first thing to be observed in Speech is, that we do not deceive any one by our Words, or by other Signs used instead of them, for the expressing of the Sense of our Minds. For the Truth of our Speech or Words must be constant and inviolable, after the same manner as we find that amongst Animals, some outward Species do remain, whereby they discern things Friendly or Inimical to them.

To the end the Præscript of this Natural Law may be the better understood, we are to take Notice, that a double Obligation lies upon those that speak, with Relation to their Words or Speech. First, That those who use the same Speech or Language, do make use of certain and determinate Words, to signifie such certain and determinate Things, according to the use of the Language that is received in the Country or City where a Man lives. For it is not lawful for any one, at his own pleasure, to Coin new Words, but must make use of those, which have been long approv'd of by Use and Custom, and signifie things according as they are taken and understood by all. Secondly, That every one do so open his Mind to another, as clearly to manifest what he intends, and so as that the same may be clearly apprehended by him he speaks to. This Obligation may arise, either from a particular Agreement a Man hath made with another, to discover unto him what he knows about such a business. As when one Agrees with one that is Master of any Art, to be taught the same by him: Or, from the Precept of the Common Law of Nature, whereby a Man is bound to impart his Science to another; either for his Profit and Advantage, or to prevent some Evil that threatens him: Or, when by Law, whether Perfect or Imperfect, a man is bound to discover those things, concerning which he is Interrogated.

But if those to whom we speak be of such a Temper, that an open and simple Declaration may be prejudicial to them, or that it may give them occasion of hindring and opposing what we are about; it may be lawful for us to dissemble our Minds at that time, and to palliate our Intentions. For though it be our Duty to do good to others, yet are we not bound to do it, when we have good Reason to believe, that in so doing we shall be cross'd in the thing we intend. Neither is this to be call'd Lying; for tho' our Words do not exactly represent the Sense of our Mind, yet do they not of set purpose carry another Sense, than our meaning really is; nor hath he to whom we direct our Speech, any Right to understand or know them: Neither are we bound by any means to cause him to apprehend our Intentions. For it is frequently Expedient in Human Society, that the Truth should be hid, and that the thing which is about to be undertaken, should be kept from the Knowledge of many.

From

I.
Deceitful-
ness in
Speech is
to be a-
voided.

II.
Conditions
to be ob-
served in
Speech.

III.
When we
may dissem-
ble our
Thoughts.

IV.
Fiction is
in Lie

From what hath been said, may be gathered, that he is not to be lookt upon as a *Liar*, who at *play*, by set *Words* and *Gestures*, endeavours to conceal his Intentions, to deceive the party he *plays* with, and to inveigle him to do that whereby he may lose the *game*. Nor he, who by *feigned Stories* and *Fables* deceives the *Minds* of *Children*, who are not yet capable of down-right *Truth*, with a design to excite them to the *Love* of *Vertue* and the *Hatred* of *Vice*. Nor he who imposes upon an *Angry Person*, comforts one that is *sorrowful*, or by colour'd *Speeches* persuades a sick person, that the *Medicin* he is to take is very grateful and pleasant. Because none of these are done with a design to deceive or wrong, but on the contrary, to do them good, and to ease them of that *Passion* which afflicts them. But the case is quite different where a man is bound to declare his *Mind* to another; because by using doubtful *Speeches*, or discovering only one part of the *Truth*, he becomes unfaithful, and sins against the *Rules* of *Justice*.

V.
What an
Oath is.

Our *Speech* is capable of being ratified and confirmed by an *Oath*. For an *Oath* is the calling of *GOD* to witness to the *Truth* of what we do assert: Or as others will have it, *It is a Religious Act, whereby we call upon GOD as the Supreme Truth, in witness to a thing, that is not sufficiently known to others*. And accordingly the very *Heathens* themselves knew of no stronger tie whereby to engage to be faithful and to speak the *Truth*, than that of an *Oath*. For they who take an *Oath*, do bind themselves by the *Aw* and *Reverence* they have for *GOD*, to be as good as their *Word*, and to stand to their *Covenants*. And forasmuch as they own that *GOD*, whom they worship, to be Omnipotent and Omniscient, it is to be believed, that no *Man* is found so wicked, as to dare to provoke his Indignation, and to engage his *Revenge*. Wherefore he also who *swears* by false *gods*, supposing them to be true, is bound to perform what he hath *sworn*, and if he breaks his word, he is *Perjur'd*.

VI.
Three kinds
of Oaths.

An *Oath* is either *Affertory*, when we make use of it to confirm an Assertion about a thing present or past; when no better way is found to discover the *Truth*. And such an *Oath* as this is required of *Witnesses* before a *Judge*, or from others, who some other way have any knowledge of the *Fact*. There is another *Oath*, which is called *Promissory*, when one by *Oath* promises any thing to another, and binds himself to the performance thereof. And lastly, there is another *Oath* of *Decision*, where 2 are that are in contest together, and presenting themselves before the *Judge*, one of them by taking an *Oath*, doth decide the matter in contest.

VII.
Of the Con-
ditions to be
observed in
every Oath.

That there may be an *Obligation* upon a *Man*, to keep his *Oath*, it is requisite, *First*, That he know the thing to be *true* or *false*, which he asserts or denies by *Oath*; or whilst he *speaks*, according to what he thinks, and is persuaded thereof, whether it be so or not. For he that *swears* to any thing which he judges to be so, his *Oath* cannot be blamed, because he speaks according to what he thinks and is persuaded. *Secondly*, It is requisite that he take his *Oath* Seriously and with mature *Deliberation*. And therefore he who repeats the *words* of an *Oath* to another, is not bound

thereby; but he that speaks them *seriously*, and with the posture and formality of those that take *Oaths*, tho' it may be, he intends nothing less in his *Mind*, than to be true and faithful to what he *swears*.

Wherefore I cannot assent to their *Opinion*, who suppose that a *Man* who is brought before a *Judge*, about a Debt of 100 pieces of *Gold* which he owes to another, may *swear* falsely, in case he knows that the payment of that *Money* should cast him into extream Difficulties. For they seem to suppose, that *GOD*, the Sovereign of *Truth*, may be produced as the witness to a *Lye*; as if he did not behold, and in due time would *Judge* and *Revenge* those, who, in so daring a manner, do affront his *Majesty*. For what else is it to deny a just *Debt*, but to deny *GOD* to be Just and Equal, and to promise impunity to *perjured Persons*? For if it be lawful for a *Man* to forswear himself, and to think one thing, and speak another, the validity and reverence of *Oaths*, and of all *Covenants* and *Contracts* will be banisht from the *Societies* of *Men*, and nothing but *Fraud*, *Deceit* and *Iniquity* will be found in all their agreements and dealings together.

Yet must not every *Oath* be taken for such, except that we be assured that it hath all the *Conditions* requisite to a Valid and Lawful *Oath*, and which ought to be rigorously, and not perfunctorily examined. For he, who out of *hatred* *swears* against another; or he, who being terrified by the *Threats* of an *Enemy*, doth confirm his *Promise* with an *Oath*, is supposed not to have *sworn* at all, seeing that he never did it with any voluntary *Deliberation*, but being hurried on by fear and *Passion* only. In like manner he, who promiseth somewhat to another indeterminately, and confirms his *Promise* with an *Oath*, is not bound thereby to grant to another what is dishonest, absurd or hurtful; because it is supposed, that he who hath made the demand is led by reason, and consequently would not desire any thing that is morally impossible or unjust.

VIII.
We must
not swear
contrary to
our Consci-
ence.

IX.
What is to
be consider-
ed in him
that swears
or takes an
Oath.

CHAP. XXXI.

Of Dominion, and the Duties thence arising.

Nothing is more celebrated in the *Writings* of the *Antient Poets*, than their state of the *First Men* in the *World*.

I.
The State
and Condi-
tion of the
First Men.

*The Golden Age was first, which uncompel'd,
And without Rule, in Faith and Truth excel'd.
As then there was nor Punishment, nor Fear;
Nor Threatning Laws in Brass, prescribed were.
Nor suppliant Crouching Pris'ners shook to see
Their Angry Judge; but all was safe and free.*

For they tell us, that at that time all things were common, and that the Terms of *Mine* and *Thine*, now too familiar, were not known. So as that the care and thoughts of all *Men* conspir'd only for the good of the *Publick*, and every one neglecting his own particular concerns, was only solicitous for the Interest and Welfare of the whole *Society*. But whatsoever they may talk of this Community, it appears, that from the Beginning of the *World*,
H h h h things

things were accounted, as of right, belonging to him who was the first *Occupant*, and that every one did challenge that to be his own, which by his *Labour*, *Industry*, or *Good Fortune* he had got possession of. As it is evident in *Abel* and *Cain*; who, tho' they were *Brethren*, yet had each of them their distinct *Families* and distinct *Possessions*: for how else could they have offered a *Sacrifice* to *GOD*? Or how could that which was offered in common by them, be accepted and rejected? Wherefore we must conclude, that every one by an instinct of Nature, out of the *love* he bears to himself doth affect the Possession of *Goods*, and is ambitious of a Lordship or Dominion over other things.

II. *Dominion is the Power or Right which a man hath over a thing, to dispose of it, as of a substance belonging to him.* Whence it is that a Possessor or Owner, can dispose of the things that are his, as it best pleaseth him, by giving them away, Exchanging or Selling them, and hindring any one else from making use of them, except they be such things as are proper to many, and belong to the *City*, or some other *Society*.

III. *Dominion is acquired originally by occupation of what never belonged to any.* There are 2 General ways of acquiring *Dominion*, viz. *Originally* and *Derivatively*. By the former of those ways we acquire the *Dominion* of a thing by *Occupation*, when it did not belong to any one before, but was by the profuse Bounty of Nature exposed to the first *Occupant*, or him who first challengeth it for his own. For seeing that all things, at the Beginning, were produced for the *Good of Men*, and therefore may fall under their *Dominion*, it was ordered by a just Right, that things should be his who first claimed them, and that he should safely enjoy them, who had got them into his possession before all others. Wherefore, because under this name of *Occupation*, are understood *Fowling*, *Hunting* and *Fishing*; the *Birds* of the *Air*, the *Beasts* of the *Earth* and *Fishes* of the *Sea*, according to the *Law of Nations*, begin of right to belong to him who first takes them. For what before belonged to no man, that by *Natural Right* becomes his who first occupies or seizeth it, *Justinian Inst. l. 2. de Rer. Divis.*

IV. *By Occupation of what the Owner hath relinquished.* Things also may be acquired by *Occupation*, if they be dereliquishd by the *Lord* or *Owner*, with the design of never esteeming them for his own any more, and consequently ceaseth to be *Lord* over them. But the case is not the same in things which during a storm, are cast into the *Sea*, with a design to lighten the *Ship*; for these do still continue to be the owners; because it is manifest that he did not cast them *overboard*, because he had a mind to be rid of them; but that by the casting of them into the *Sea* he might save the *Ship*, and consequently his *Life*.

V. *Dominion is by several ways Derivatively acquired.* The second way of acquiring *Dominion* is, either by *Tradition* or *Delivery*, as when a thing passeth from one to another. For nothing is more conformable to *Natural Equity*, than that his *Will* should stand, who has a mind to translate the *Dominion* of a thing that belongs to him, to another. And therefore of whatsoever nature a *corporal thing* may be, as the *Lawyers* say, it may be passed over to another, and being thus past over by the *Lord* or *Owner*, it thereby becomes alienated. Or by *Emption* or *Purchase*; and things

so acquired, by paying unto the *Seller* the sum agreed upon, or satisfying him some other way, as by *Promise* or giving him a *Pledge*. Or by a *bare signification of ones Will*; as if a man who hath lent, let, or deposited any thing with me, should afterwards sell me the same, or bestow it upon me: for in that he suffers it to be *mine*, I immediately acquire a right to it, as effectually as if he had by deed past it over to me. Or by *Succession*, as when a *Man* dies *Intestate*, for then all his *Goods* are devolved to his next *Heirs*. For it is agreeable to Reason, and conducive to the *Peace of Human Society*, that what a *Man* hath in his *Life-time* acquired by his *Labour* and *Industry*, should not be lookt upon as things dereliquishd, and so left to the first Seiser, but that they should be the *Heirs* of him who dies *Intestate*, that are nearest in *Blood* to him.

There is also another way of acquiring *Dominion* by long *Possession* or *Prescription*; when a *Man* hath honestly acquired a thing, and hath posselt the same without Interruption, the Term of time set by the *Law*. Because according to the *Law of Nations*, that is lookt upon as relinquishd and forsaken, which for so long a time hath not been challenged by any *Man*. And therefore after the Term appointed by the *Law* is expired, he who is in Possession is not bound to restore the thing he hath been so long posselt of; but the *Dominion* or *Propriety* thereof is devolved upon him, and he may lawfully keep the same, not only in the outward Court, but also in the Court of Conscience because the *Sovereign Magistrate* is supposed to have Power for the Publick Good to enact, that after a long continued Possession, the *Goods* of one *Man* should be transferred to another, lest continuing so long doubtful, it should perpetually give occasion to fresh suits at Law.

The following *Laws* seem to have taken their Rise from the acquiring *Dominion* of *Corporal things*. The First whereof is, that no body disturb the Possession of another, but that he suffer him with Peace and Quietness to enjoy his acquired *Goods*: so as not fraudulently to be the cause of any detriment or damage to him, or by any way contribute to the taking of them away from him. By which Law, Theft, Rapin and other unjust Subtractions of *Goods* are forbid. So that not only the violent taking away of another mans *Goods* must be avoided, but also those which are clandestine, and the Owner is ignorant of.

Secondly, If the *Goods* of another be honestly fallen into our hands, without any fault of ours, we are to do our Endeavours to find out the true *Lord* and *Owner* of them, that they may be sent back to him, as soon as he shall be known to us. But yet there is no obligation upon us, to restore the same at our own Cost and Charges; but we may justly demand the Charges we have been at in keeping or restoring the same, and keep the *Goods* till the same be repaid us. But as to those things which we have honestly purchased, and have a clear Title to, these we are not bound to call in question before him, and, as it were, make known to all, whether he will account it amongst things that are lost; because we are assured of the *Equity* of the Contract or Bargain whereby they are become ours. Yet when we have certain knowledge, that any stolen *Goods*, have been deposited with

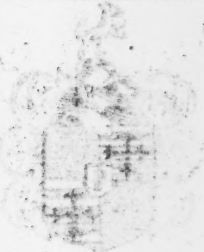
VI. By long Possession or Prescription.

VII. The first Law that is to be observed after Dominion is acquired.

VIII. The Second Law.



The Right Hon.
 George James
 the Secretary
 of the
 Hospital of St. John
 of Jerusalem in
 the City of London
 to the Hon.
 the Lord Bishop of
 London





Leone. Inv.

J. Kip Sculp.



To the Right Wor-
Leveson Gower
the County of



= shipfull S^r John
of Trentham in
Stafford Baronet

This Plate is, humbly

Dedicated by Richard Blome

with us, without our knowledge, we are bound to restore the same, not to the *Thief*, but to the true Owner.

IX.
The Third
Law.

Thirdly, If we have spent any Goods belonging to another, which we honestly came by, then only the Obligation lies upon us, of restoring so much to the Owner, as we have profited thereby; and if we have not profited by them, neither are we bound to restore any thing. The Reason is, because he who is honestly possessor of a thing, is not bound to restore the thing, upon the account of any unjust coming by it, since he both came by it and spent it honestly. Nor by reason of the meer receiving it, seeing that no more of it is left. Only he is bound to make restitution, if he be grown more Rich by it, that is, if thereby he have spared those charges which otherwise he would have been necessitated to; or have something, which otherwise he could not have.

X.
The Fourth
Law.

Fourthly, If any thing that belongs to another be acquired by a chargeable Title, it is the duty of the Possessor, to restore the same to its true Lord; neither hath he any Right, to demand of the Owner, the Money he hath laid out for the Purchase of it; but can only demand it of him, from whom he hath purchased the thing. Except it be made appear, that in all probability the Owner could never have recovered his Goods without being at some Charges, or that he hath of his own accord promised a reward to him, that should find them, or tell him news of them.

C H A P. XXXII.

Of the Duties of Married Persons.

I.
Why Ma-
trimony
was infi-
tuted at
first.

THE first Divine Institution appointed for the Good of Man, was that of *Matrimony*, which accordingly hath been celebrated and esteemed in all Nations. For the order of Nature, and the necessity of Life do require, that Men should by Propagation preserve their kind; and by a continual Succession secure Mankind from utter perishing. Hence it is that Men take to themselves Conjugal Companions, and by means of the said meet-helpers, at once provide for their Posterity and Welfare. For seeing that *Matrimony* is nothing else but the Lawful Conjunction of a Husband and Wife, accompanied with individual intimacy and familiarity; whosoever enter upon the same, do it with intention of passing the whole course of their lives sweetly and pleasantly, by means of this mutual consent of Souls and Bodies: forasmuch as they would never desire it, but out of an inclination to propagate a Succession, and from hope of the Happiness they shall enjoy in that State.

II.
All Impu-
rity and
Filthiness
is contrary
to Nature.

About *Matrimony* we are to observe, that this vehement desire of the other Sex, was not put into Man by GOD, for the satisfying of his voluptuousness, which is base and infamous, and always drags Repentance after it; but to the end that married persons might live more happily together, and propagate Posterity, which is of absolute necessity for the continuation of Mankind. Whence it follows, that it is contrary to the intent of Nature to defile ones self by Lust, and to desire any other pleasures, but what the Nuptial Bed affords.

Forasmuch as Man is placed in this World, not as an absolute Lord, but only with permission to use and enjoy the things that are in it, without destroying or hurting the substance of them; an Obligation seems to lie upon him, to enter upon Marriage, that he may render to Nature, what he hath received from her, by begetting Childring to supply the room of his Parents and Ancestors. For Human Society cannot, without great inconvenience, permit the Propagation of Human kind any other way than by lawful Marriage; all other promiscuous and wandring Lusts being condemned, and punished by it, whereby either an unjust Heir is clapt upon an Estate, or a Virgin is vitiated. Yet is not every one therefore bound to Marry; seeing that the Nature of some is repugnant to it, and the habit and constitution of their Body does not comport therewith. But those only who cannot well live without a Wife, or who think they shall be more useful Members of the Commonwealth, by marrying, than if they should continue in a single state.

They who are married must steadfastly resolve never to break the Conjugal Bond, by any unlawful Lust; for by means of the said Marriage knot, the Husband belongs to his Wife, and the Wife to her Husband: so that he who separates them, ought to be looked upon no better than a Murderer, and to be as severely punished. The Savages, who live in America, do prove this to be a law of Nature, by the keeping of their Nuptial Beds undefiled, Adultery being scarcely known amongst them; and if ever any be found guilty thereof, they have horrid punishments inflicted upon them. And tho' after Marriage the Husband be the Head of the Wife, and that by the Prerogative of his Sex he is to have the Dominion, and that all Domestic Affairs are to be ordered according to his Command and Direction; yet he is never a whit less obliged to keep his Conjugal Promise, than the Wife is; and if he happen to break the same, he needs not think strange if his Wife take the same course, and write after the Copy he sets her.

Forasmuch as a House or Family seems to be perfect and compleat in a Husband and Wife, and that the welfare of a Family consists in their Concord and Harmony; it highly concerns them diligently to mind their Duties. Now the Duty of a Husband is to love his Wife, and to be tender of her, as of a part of himself; according to that of Genesis, and they two shall be one Flesh. Neither is it sufficient that he make her the Companion of his Bed, but also of his Counsels, lest she should conceive her self to be contemned and slighted, and thereupon, out of Indignation, neglect her Family Affairs. If he admit her into Partnership of all his concerns, this will make her cheerfully to undergo any pains or trouble, and ready to comfort, assist and help him in any occasion of Grief of Mind, Bodily Sickness, or outward Losses. But if a Man hath had the ill luck to meet with an ill natur'd Wife, he ought first of all to use his utmost industry to engage her to her Duty, by sweetness and fair means. And if after all, she continue in her perverseness, he may have recourse to a Divorce, or some other way the Law allows; or else by Patience endure what cannot be mended, especially seeing that he cannot divulge the faults of

III.
There is a
kind of ob-
ligation
upon Man
to enter up-
on Matri-
mony.

IV.
Married
Persons are
bound to
keep the
Faith they
have pled-
ged to each
other.

V.
The Duty of
a Husband

VI.
The Duties
of a Wife.

of his *Wife*, without the hurt of his *Children*, the infamy of the *Mother*, and the disgrace of his *Family*.

'Tis the *Duty* of a *Wife*, not only to love her *Husband*, but to Honour him, to subje& her self to his *Command*, as to her *Head* and *Lord*. And because she is more fit for the managing of *Household Affairs*, her business must be to take care of them, and to provide for the Convenience and welfare of all those that belong to the *Family*. And on either side is required union and concord of *Mind* and *Body*, that they may have but one will between them, and never be divided by any difference or contest. According to that of HORACE, *Carm.* 1. *Od.* 13.

O Happy thrice and more, that Faithful Pair,
In Bands of lasting Love that joined are;
Who without Angry Broyls their days do spend,
Whose Love no sooner than their Lives shall end.

VII.
Matrimony
is to be ce-
lebrated
between
Equals.

To the begetting of this *Concord*, it is very conducive, that there be a *Parity* between the married Couple, and not too great an inequality of condition between them. For seldom are those *Marriages* found to be happy, where there is a great difference between the parties conjoin'd. Seeing that great disparity of *Fortune*, *Age* and *Manners*, are frequently the cause of as great differences and dissensions: but those above all other are frequently found the most unfortunate, that are contracted between persons of a different *Religion*. For as TERTULLIAN saith, how can it be imagined, but that the *Faith* must be weakned and obliterated, by continual and intimate commerce, with one of a contrary *Belief*? Wicked *Discourse* is apt to corrupt good manners, how much more the individual intimacy of *Conjugal Cohabitation*? How can a Believing *Wife* serve two *Masters*, *Christ*, and her Unbelieving *Husband*? Neither hath a *Husband* less cause to fear the Snares of an Infidel *Wife*, which SOLOMON himself, tho' the wisest of Men, could not avoid, and *Children* also being mostly left to their *Mothers* care, are in great danger to be inveigled with her sentiments. And what is worst of all, from the different *Religions* of *Father* and *Mother*, as from two *Animals* of a different *Species*, monstrous Births are commonly produced, being of no *Religion* at all, and such as prove unhappy *Prodigies* in the *Church* and *Commonwealth*.

C H A P. XXXIII.

Of the Duties of Parents and Children.

I.
Of the
Caution
that is to
be used in
Conjugal Co-
habitation.

Forasmuch as from the Individual Society, and Cohabitation of *Man* and *Wife* *Children* do proceed, and by means thereof the succession of *Families*, *Kindred*, *Estates* and *Titles* are perpetuated; it highly concerns *Parents*, that they behave themselves prudently in the *Conjugal Union*, lest by their intemperance their off-spring be vitiated. For it was not without Reason, that some have been reproached with this stinging Taunt, *Thy Father begot thee when he was drunk*. For the *Vices* of the *Parents*, are frequently transferr'd to their *Children*; and the very temper of their *Bodies*, is a cause either of the commendable, or perverse *Manners* of them.

The *Duty* of the *Mother*, is to take care that the *Child* in her *Womb* do not come to any hurt, and when Born, that she sollicitously cherish it, and suckle it her self, and that she do not put it out to a *Nurse*, without urgent necessity. As soon as it comes to the use of reason, she must also endeavour to form its tender and pliable *Manners*, according to the rules of *Vertue* and *Piety*, and to instil into it the first *Principles* of *Religion*.

But because it imports little to have given Life to *Children*, and thereby to put them into a State, that is indifferent to either *Vertue* or *Vice*, except due *Instruction* be superadded, and the *Hatred* of the one, and *Love* of the other be inculcated into them; it is the *Fathers Duty*, to take care that they be timely taught, according to his Ability and Condition, and he must omit nothing, that may conduce to their advancement in *Learning* and *Good Manners*. If he be able, let him put them out to *School*, to the end that being out of their *Mothers sight*, and rid from her fondling of them, they may mind their *Learning* the better: But he must so resign the care of their *Instruction* to others, as not wholly to neglect it himself, but must have an Eye to the Progress they make, by prescribing what they ought to learn, and judging what may be omitted: Except he be assured of the Ability, Care and Prudence of the *Masters*, with whom he hath intrusted them.

Another *Duty* of *Parents* is, that they take care of the *Bodily Sustenance* of their *Children*; and in case they want wherewith to maintain them, that then they take care to teach them such *Arts*, whereby they may be able to maintain themselves, without being burthensome to them. Neither must only *Legitimate Children* be maintained by *Parents*, but *Natural* also, that is, such as are Born without *Wedlock*. For according to the *Law* of *Nature*, they ought to be provided for by their *Parents*; and tho' they cannot be said to be Members of the *Commonwealth*, yet they are like *Warts* and *Corns*, which tho' they be no parts of the *Body*, yet are fed from the substance of the *Body* to which they adhere. And therefore l. 3. de inof. Test. Bastards are allow'd an *Action* at *Law*, whereby they may oblige their *Parents* to give them a *Maintenance*, as well as if they were *Legitimate*.

Parents likewise are obliged to bear an equal *Love* to all their *Children*, without putting any difference between them; for seeing they all of them stand in the same relation to their *Parents*, they ought also to be cherished with the same *Love* and *Affection*; neither is any difference to be made between them, as to their right of *Inheritance*, except the particular *Prerogative* of *Primogeniture*, and where the *Laws* of the *Society*, wherein they live do require it. Wherefore the *Civil Law* gives the *Children* power of bringing an *Action* of an *inofficious Testament* against a *Father*, who by his last *Will* bequeaths his *Estate* to others, passing by his *Sons* and lawful *Heirs*; and the *Falcidian Law* allows them the fourth part of the *Estate* to be equally shar'd amongst them. But yet it is lawful, and permitted to *Parents* to love them more, and bestow more upon them, in whom they discern more *Obedience* and *Vertue*; because this is no more than is due to their worth, they being no otherwise preferr'd before

II.
The Duty
of Mothers.

III.
The Office
of Fathers.

IV.
Parents
are bound
to main-
tain their
Children.

V.
Parents
must love
their Chil-
dren alike.



To the Worshipfull Peter
Castle in Ospring in Kent
of Collonell Phillip Rycaut,
Right Worshipfull S.^r
Envoy Extraordinary to
Brittaine in Hamburgh;
Daughter of S.^r Gilbert
This Plate is humbly



Rycaut of King Stephens
Esq^r, only Son and heyre
And Nephew to the
Paul Rycaut Knight,
their Majesties of great
And to Chorlotte his Wife,
Gerard Baronet deceased.
Dedicated by Richard Blome.



Leiss. Inv.

L. Kip Scul.

To the Right Worshipfull
Marden in Surrey, and
Knight and Alderman
Anno Domini 1680,
Lady Daughter of
of London



S^r Robert Clayton of
of the City of London
Lord Mayor thereof
And to Martha his
M^r Perient Trott
Merchant.

This Plate is humbly

Dedicated by Richard Blome.

VI.
Children
are under
the Power
of their
Parents.

before the rest of their *Brethren* or *Sisters*, but as they are more worthy.

Parents by a natural right have power over their *Children*, for seeing that the care of them is by nature committed to the *Parents*, they would never be able to exercise the same, except they had Authority over them, to direct their *Actions* for their Good. And accordingly the best of *Parents*, do without any injury to them, force their *Children* to follow their Studies, to behave themselves as they ought, to leave the vicious inclinations of their Nature, and to do those things which for the future, may make them good, and profitable Members of the *Commonwealth*. Now whilst the *Father* is in this exercise of his power over his *Children*, there is besides a great Obligation incumbent upon him, that as he is the head of the *Family*, he take care also to impart *Health* and *Strength* to the rest of the *Members* of it; that is, that he recommend *Vertue* to them by his Example; and that he excel all the rest by his Life, more than by his *Tongue* or *Instructions*. That he deny and force himself, and that like an *Eagle* he provoke his young ones to fly; that he curb his *Passions*, that he may the more effectually excite them to follow the Footsteps of *Vertue*; and in a word, that he omit nothing whereby their tender springing *Vertue*, may thrive and flourish.

VII.
The Power
of Parents
over their
Children is
limited.

The power of *Parents* over their *Children* is bounded: For it is not lawful for them to kill the *Birth* of their own begetting in its *Mothers Womb*; nor when it is *Born*, may they neglect, much less destroy it. For tho' their *Children* proceed from them, and be form'd out of their very *Substance*, yet are they born in the same condition as themselves, and are capable of being injur'd by their *Parents*. True it is, that of antient time, *Parents* had the Power of *Life* and *Death* allow'd them over their *Children*, that they might be the more encouraged to take care of them. But this absolute Power to chastise the Vices of their *Manners*, that it might not lash out too far, was restrained by *Law*; It being taken for granted, that *Children* are not only born to the *Parents*, but to the *Commonwealth*; wherefore *L.4. ff. de re milit.* it is enacted, that whosoever in time of *War*, shall refuse to send his *Son* to serve the *Commonwealth*, or that shall any way maim him, that he may be incapable to bear *Arms*, shall be banished.

VIII.
What are
the Duties
of Chil-
dren.

The Duties, or rather the *Debts* which *Children* owe to their *Parents* are: First, that they Honour them, with all possible Observance and Obedience, and with an awful Veneration submit themselves to them. For it is their Duty to acknowledge their *Preeminence*, and their *Dominion* over them; from whence the *Royal* and *Civil Power* are originally derived. And this Honour is in a twofold manner exhibited unto them; Inwardly, by the Affection and Esteem they have for them; and Outwardly, by their Words in Speaking to, and of them with all Reverence and respect; by Signs and Effects, as by rising up to them, serving them, staying off Harms, and procuring their Good and welfare; by obeying their Commands, by submitting to their Will in all things, and by undertaking nothing without their Authority and Counsel.

In the Second place, *Children* are bound to succour and relieve their *Parents*, if they be Poor and necessitous, as being Debtors to them. This is that which Nature teacheth, and which obtains amongst all Men, by the Law of Nations. It is an ancient Law, quoted by *SENECA*, *Contravers. 1. Let Children maintain their Parents, or else be cast into Prison*. Because *Parents* here on Earth, are instead of *GOD* to their *Children*, tho' they may labour under Adversity and Poverty. They are as *Creditors*, to whom tho' they be impious and contemners of the *Laws*, the Debt that is due to them must be paid notwithstanding. They are like so many *Sovereign Princes*, whose *Actions* and *Counsels* the *Subjects* may not pry into. And therefore *Divines* determine, that if a Man should meet with his *Father* and his *Son* in the same danger, and that he can only save one of them, he is bound to rescue his *Father*, rather than his *Son*. For to this he is bound by the tie of *Blood*, *Reverence* and *Gratitude* he owes to his *Father*; since he may have another *Son*, but cannot have another *Father*.

IX.
Children
are bound
to maintain
their indi-
gent Pa-
rents.

CHAP. XXXIV.

Of the Duties of Masters and Servants.

After that Men were multiplied by Generation, Servitude was introduced into the World, and they who were born free, were forc'd to own Superiors. For after that Dominion and Government, was come into the Hands of a few Men, many being compell'd by Poverty, or by the Dulness of their *Intellectuals*, did proffer their Labour and Service to great Men, upon condition of being maintained by them, and supply'd with necessaries. Afterwards by the occasion of Wars arising between several Nations, and the longest Sword carrying it, it so happened that they who were taken in War, were made *Slaves* to those who had conquered them. And therefore the Latin word *Servus*, which signifies a Slave or Servant, is derived from *Servo*, which signifies to Save, because they were such as in War, were saved alive by the General. *S.3. Just. de Jur. Person.*

I.
The Origin
of Ser-
vitude.

But this Custom is antiquated amongst *Christians*, and it is a received Law amongst them, that no *Christians* may be made *Slaves*. Tho' when *Christians* wage War against *Infidels*, and are taken by them, they make *Slaves* of them, because this is the Common Law of Nations; and this Servitude is a kind of Permutation for the Death, to which it was in the power of the *Infidels* to make them submit. For tho' it be contrary to Nature, to enslave a Man that is born free; yet it seems consentaneous to Natural right, that he who rashly takes up Arms against one that is more powerful than himself, and will not hearken to Peace, being taken Captive by the Conqueror, should be obliged to serve him, and be subject to his Command.

II.
How Chri-
stians be-
come Ser-
vants.

The are 2 sorts of *Servants*; the one, of those who contrary to the Law of Nature, are entirely at the Will and dispose of a strange Lord, or Master: Another are such, as let themselves to others for Hire, and give them their Labour for Recompence or Reward.

III.
Two sorts
of Servants

IIII

The

IV.
The mutual
Duties of
Masters
and Ser-
vants.

The Master is bound to pay to his Temporary Hired Servant, the Wages he hath agreed with him for, and be as good as his Word to him; as the Servant on the other hand is obliged to perform the Work and Service he hath agreed to, and diligently effect whatsoever else he hath engaged himself to do. And forasmuch as in this their mutual Contract and Agreement, the condition of the Master is above the Servant, an Obligation ariseth thence in the Workman, to carry himself with all Reverence to his Master, according to the degree of Dignity, wherein he is placed above him. If he have not been faithful in performing, what he had engaged himself to do, or not diligent enough in his Work, that he willingly submit himself to his Correction, to receive the reward of his Negligence or Wickedness. If a Servant either driven by necessity, or of his own accord, have put himself into any ones Service, his Master is bound to provide for him accordingly. Neither can the Ingratitude, or Obstinate humour of the Servant deliver him from his Obligation herein; tho' for a Punishment of his Offence, he may diminish his allowance of Food, to chastize his negligence or sturdy humour. Yea if he should neglect the Commands laid upon him, and should refuse to go through the work he had undertaken, the Master may withhold part of his Wages, which he had agreed with him for.

V.
A Master
is bound
to pay for
his Ser-
vants.

A Master is bound to make Good the Damage done by his Servants: Because the fault of his Servant is imputed to be his; and according to the Lawyers, an Action may be had against the Master of the Bondslave, for any Damage Culpably committed by him: And accordingly the Master must either make good the Damage, or deliver his Slave to him who hath suffered the Damage. Thus the Master of a Ship is bound to make good the loss of it, in case it chance to miscarry in a Tempest, for want of a good Steersman. I added Culpably committed by him, because if the loss happen without his fault, neither the Servant nor Master are bound to make it good, except that it can be proved, that he is grown Richer by means of the said loss.

VI.
The care of
Masters to
wards their
Servants.

A Master must not suffer his Servants to be Saucy or Idle, and if he finds them remiss and negligent in their Work, he ought to reprove and chastise them. If they commit any Crime, he may punish them according to the quality of it, yet not over-cruelly. I call a too cruel Punishment, Maiming, Wounding, or such grievous beating whereby the Life of the Servant would be endanger'd, or at least the loss of one of his Members. It is only permitted therefore to a Master, to correct his Servant by a lighter sort of Punishments, as by beating him in such a manner, whence no hurt can redound to his Body. For seeing that Servants are subject to their Masters Chastisements, they ought to submit to that Punishment, he thinks fit to inflict upon them.

VII.
Servants
can enter
into Coven-
ants.

Servants notwithstanding the tye they are under, yet can enter into Covenants or Contracts, so that by this means they may be under an Active, as well as passive Obligation. For tho' Servitude do restrain the Power of Servants, and almost deprives them of Civil Rights; yet it leaves them in full possession of the Law of Nature, which by no means can be abrogated. And accordingly

JUSTINIAN tells us, *Inst. de Jur. Nat. Gent. & Civil.* That Natural Laws which are equally observed by all Nations, are the constitutions of the Divine Providence, and as such do always continue firm and immutable. Whence it follows, that both Servants, and those with whom they have contracted, are in the Court of Conscience bound to the Observation of their Agreements, and the faithful performance of what they have engaged themselves to do.

Servants have no power to alienate their Masters Goods, no not so much as to give an Alms; for seeing that no Administration of their Goods is committed to them, and that it is a piece of Injustice to relieve the Poverty of the Indigent out of the substance that belongs to another, it is clear that they cannot bestow any thing upon the Poor; without it can be probably supposed, that they have their Masters consent for it; or that the necessity of the Indigent be so extream, that it may seem to plead an excuse for the irregularity of the fact.

Servants are not bound to obey their Masters, in those things that are Evil in their own Nature, that is, which are contrary to the Laws of Nature or Nations, or to the Law of GOD, whatever advantage either themselves or their Masters might hope to reap from it. Because we are never to do any Evil that Good may come of it. Wherefore they who either by their command or advice, do intice their Servants or others to Evil, or that put an occasion of doing mischief into the Hands of others, to the end that they may get some advantage thereby, do greatly Sin in so doing, they making themselves guilty of the Crime, who persuade or command it.

VIII.
Servants
cannot alie-
nate the
Goods of
their Ma-
sters.

IX.
Servants
are not
bound to
obey their
Masters in
any thing
that is E-
vil.

CHAP. XXXV.

Of the Right of Sovereign Dominion, and the different forms thereof.

THE Right of Sovereign Dominion, besides what is Paternal, took its Beginning, when Men like Beasts, lived in the Fields, Woods and Caves of the Earth: for being wearied with this irregular kind, they began to think of entering into Societies, and voluntarily divesting themselves of their Liberty, committed themselves to the disposal of the whole Company, preferring the Judgment of the Community before their own. The Power being thus placed in the Hands of the Multitude, they took care for the particulars belonging to it, that the great and powerful might not oppress the weak and needy, and that all the Members of the Society might enjoy the same Freedom of Living. But forasmuch as in process of time, it was found very inconvenient, both as to the deliberating about, and deciding of Affairs, to gather the suffrages of the whole Multitude belonging to the Society; they agreed that this Power should be settled on one Person only, or on a few. Whence a threefold form of Government took its Rise; so that now, as TACITUS expresseth it, all Nations and Cities are Governed by the People, or the Great and Chief Men, or by Sovereigns; so that the Supream Power is sometimes in the Hands of a single Person, or of a few, or in the Hands of the Body of the People.

I.
When So-
vereign
Power had
its rise.

When



Lenox. Inv.

I. Kip Sculp

To his Sacred
by the Grace of
England, Scotland,
Defendor of



Majestie William
God, King of
France, and Ireland,
the Faith &c^a

This Plate in all humility is most

humbly Dedicated by Richard Blome



II.
Of the
three kinds
or forms
of Govern-
ment.

When the *Sovereign Command* is in a *single Person*, this is call'd *Monarchy*, because he *Governs* the whole *People*, and himself is commanded by none; as the *Kingdom of France, Spain, &c.* When the *Supream Power* is lodg'd in a *Council* of a few select *Citizens*, this is call'd *Aristocracy*; such as obtains in the *Commonwealth* of the *Venetians*. And lastly, When the *Command* is in the *Hands* of the whole *Body* of the *People*, it is called *Democracy*, or a *Popular Government*; such as is in *Holland*. Every one of these *Forms of Government*, hath its own *Peculiar* and *Fundamental Law*, which it more particularly insists upon; *Democracy*, that of *Liberty*; *Aristocracy*, *Security* and defence from the *Common People* and *Tyrant*; and *Monarchy*, *Sovereign Power*, employ'd for the safeguard of the *Publick Good*.

III.
The Wor-
thiness of
Monarchy.

Monarchy therefore is, when the *Supream Power* is lodg'd in one *Person*, on whom all the rest do depend. Altho' this *Form of Government* may agree with the other two, yet doth it excel them both, as possessing more *Advantages* than either of them. For *Monarchy* hath this *Peculiar* to it self, that it is more free in the *Exercise* of its *Power*, and can deliberate and determine without any set *Time* or *Places*, it being at the *Kings Liberty* to *Deliberate* or *Determine* at any time, or in any part of his *Kingdom*. Moreover it is obvious, that in *Kingly Government*, *Counsels* are carried on, as well as resolved, with greater *Secrecy*; Executed more readily; *Factions* and *Seditions* more easily prevented and crush'd; and *Safety* and *Liberty*, which the other *Forms of Government* so much affect, doth more abound, and is more lasting than in the two other *Forms*.

IV.
In it all
things are
better ad-
ministr'd.

If there be any *Deliberation* concerning the *Peace, Union*, and the *Highest Good* and *Interest* of the *People*, the *Power* concentred in One, will be able better and more readily to effect it, than the resemblance only of this *Unity* in many can possibly do it. Besides, that *Form of Government* must needs be the best, which most resembles the *Eternal* and *Undivided Government* and *Empire* of *Almighty GOD*: As also, because he whose *Command* continues as long as his *Life*, doth thereby become perfect in the *Art of Ruling*, and looks upon the whole *Body* of the *People* as his own *Family*, and embraceth and cherisheth them with a *Paternal affection* and *tendermess*.

V.
What a
Tyrant is.

The opposite of such a *Prince* as we have now described, is a *Tyrant*, who either gets into the *Throne* contrary to the *Laws* and *Customs* of the *Kingdom*; or, who being lawfully advanc'd to it, doth only mind his own private *Good*, and fills the *Society* with *Dread*, *Poverty*, and *Calamity*. He who, contrary to *Law*, aspires to the *Sovereign Dignity*, and leaves nothing unattempted to obtain the *Kingdom* he has in his *Eye*: He who by the *Massacres* and *Destruction* of the *People*, the *Proscription* of the *Grandeess*, and the taking away of their *Lives*, makes his way to the *Throne*; without being asham'd of oppressing and grinding the *People*, or of destroying the *Innocent*, so he may but obtain what he hopes for. For *Monarchy* is not always such as it ought to be, but by the *Vices* of wicked *Princes*, is often turned into *Tyranny*. But certainly, the *State* of a *Tyrant*, whatever he may think of himself, is very miserable, who dreads those whom he oppresseth, and flees those

whom he persecutes, the *Fear* he puts his *Subjects* into, recoyling back upon himself. Seeing, that as *SENECA* saith, it is unavoidable, but that *He whom many fear, must fear many*.

Neither is *Aristocracy* subject to less *Inconveniences* than *Monarchy*; whilst *Wicked Men* out of an ambitious desire of *Rule*, do by unjust *Means* endeavour to get into the *Senate*; following that *Maxim*, *If Right be to be violated, let it be done for the obtaining of Rule and Government*. Whilst by the *Prevalency* of a *Faction*, unworthy *Persons* are *Elected*, and *Vertue* and *Desert* post-pon'd: Whilst those few that have the *Power* in their own *Hands*, do only mind the enriching and aggrandizing of themselves, and without being solicitous for the *Good* of the *Subject*, do treat them no otherwise, than if they were their *Slaves*.

VI.
The Defects
of Aristoc-
racy.

Neither is *Democracy* subject to less dangerous *Distempers*; as when the *People* in whom the *Power* is lodg'd, manages the *Government* in a turbulent and tumultuary manner; when the more *Rich* and *Powerful* part of the *People*, do oppress and devour the lesser *Fry*, condemn the *Magistrate*, violently seize the *Goods* of others, without having the least regard to those that are *Good* and *Innocent*: When they make *Laws* from an itching desire of *Novelty*, and soon after as inconsiderately annul them again: When they *Enact* and *Decree* that one day, which they abrogate the next; and *exauktotat*, what but a while ago so highly pleased them: Or, when *Men* unfit and of no *Capacity*, are raised to the highest *Charges*: And, when *Men* of an insolent and insulting *Temper*, do pronounce unjust *Sentences*, and enact burthensom *Decrees*, and afterward maintain and execute them by unjust *Rigour*.

VII.
The Incon-
veniences
of Demo-
cracy.

CHAP. XXXVI.

Of the Duties of Sovereign Princes.

IT is very much for the *Interest* of the *Common-wealth*, that He who either by *Nature* or *Chance* is destined to the *Government* and defence of *Society*, should not only excel others in *Vertue*, but also in *Knowledge of Business*, especially of those which appertain to his *Function*. For how shall a *Man* be able to perform that he doth not understand? Or prescribe *Laws* to them, whose *Temper* and *Inclinations* he is not at all acquainted with? Wherefore it ought to be his great concern to mind this only, and contemning his *Pleasure* and *Divertisments*, to exercise himself in those things which conduce to this end.

I.
Knowledge
of Affairs
is necessary
to a Prince.

The first thing therefore that is to be minded by him that has the *Sovereign Power*, is, that the same has not been committed to him for his own sake alone, but for the *Publick Good*. For as the great End, as *CICERO* tells us, of the *Master of a Ship*, is a *prosperous Voyage*; that of a *Physician*, the *Recovery of his Patient*; that of a *General*, *Victory*: So the End of a *Governour*, is the *happiness* and *welfare* of the whole *Communitie*, that so his *Subjects* may abound with *Riches*, be expert at their *Arms*, Renowned abroad, and Vertuous at Home.

II.
The great
aim and
design of
a Prince,
must be the
Publick
Good.

A

III.
Vertue and
Wisdom is
requisite in
a Prince.

A King will the more readily obtain this End, if he endeavour to excel all others in *Vertue* and *Wisdom*, as he is above them in Place and Dignity. For seeing that the whole *World* are apt to imitate the Manners of their Prince, and his *Vertues* or *Vices*, are commonly the Copies his *Subjects* write after; it is his greatest Interest to pursue *Vertue*, and lead a Good Life, that he may not be the Cause of Corrupting his *Subjects*, and encouraging them to *Sin* and *Wickedness*. Besides, how will a Prince ever be able to keep up his *Authority* and *Dignity*, if he be accounted Flagitious and Vicious? Or with what Face will he be able to prescribe *Laws* of *Temperance* to others, who lives in the continual breach of the *Laws* he prescribes?

IV.
Piety, Justice, Valour and Clemency, are the necessary Vertues of a Prince.

Of all *Vertues*, none is more necessary to a Prince, than that of *Piety*, to the end he may obtain of the Great *GOD*, by whom *Princes* Rule, *Ability* and *Wisdom* for the bearing of the Great Burthen that lies upon him; as well as that by means thereof, he may more powerfully engage to himself the *Hearts* of his *Subjects*, by their being persuaded, that he must needs be the peculiar Care of that *GOD*, whom he serves with so much *Religion* and *Devotion*. He must likewise be adorned with *Justice*, that he may Administer the Affairs of his *Kingdom* with *Equity*, Punish the Wicked, Reward those, who by their good *Services* have defended or promoted the Interest or Glory of the *Commonwealth*, and with a constant and unchangeable *Will*, give to every one his due. He must also be qualified with *Valour* and *Clemency*, that by the one he may keep Ill-men to their *Duty*, and by Fear restrain those who are apt to be *Factionous* and *Seditious*, and to disturb the Peace of the *Commonwealth*: And that by the other, he may be ready to Forgive, and gain the *Hearts* of his *Subjects* by his Goodness and Benignity. *Liberality* also is a *Vertue* that well becomes a Prince, as being of use to him, not only for the obliging and rewarding of his Good *Subjects*; but also to acquire the Reputation of *Bountiful*, which is so generally taking, and so highly esteem'd amongst Men. But yet a Prince must be prudent in the Exercise of this *Vertue*, so as to make choice of Worthy Persons, on whom to bestow his Munificence, lest by gratifying Base and Undeserving Men, he stir up *Envy* and *Hatred* in the Hearts of his *Subjects*, and expose himself to their Reproaches and Contempt. In a word, There is no *Vertue* which is not necessary for him, who is plac'd on high to be an Example to others, and whose private *Sins*, by their spreading Contagion, come to be *Epidemical Vices* of the whole *Commonwealth*. For who stands in greater need of *Prudence*, than he whose *Function* it is to deliberate concerning things of the highest moment? Who hath occasion for a more unchangeable Truth and Faithfulness to his *Word*, than he, who is greater than the *Laws*? Who ought to be so qualified with a more resolved *Constancy*, than he who is entrusted with the Concerns and Welfare of all? Who wants a higher degree of *Continence*, than a Person to whom every thing is subject? Or whom doth *Vertue* become better than him, who hath all Men to be his *Spektators* and *Witnesses*?

Another *Duty* of a Prince is, that he be well acquainted with the Temper and State of his *Kingdom* and *Cities*: Because the way of Governing is not every where alike, and according to the different Condition of *Kingdoms*, different *Laws* are to be Enacted accordingly. In the First place therefore, he ought to know what are the *Fundamental Laws* of his *Kingdom*; whether the Government, to which he is elevated, be purely *Monarchical*; or whether it have an alloy of *Aristocracy* and *Democracy*? What part the *Nobles* have of the Government, and what the *Commons*? And in the next place he ought to know the Largeness of his *Kingdom*, the *Situation*, *Commerce*, and *Strength* of it: Who are the *Neighbours* that bound upon his *Kingdom*, and what Profit or Inconvenience may accrue to him from their mutual Friendship or Discord.

A Prince also ought to be well informed concerning what passeth in *Foreign Countries*, that he may be the more ready to counterwork and oppose their Designs, to the prejudice of his *State*. For seeing that *Civil Societies* are as in a perpetual State of *War* and *Hostility*, and that in this State Men are not obliged to keep their *Treaties*: When one of the Parties gives occasion to the other, to distrust his Faithfulness; it is highly necessary, that a *Sovereign* have good Intelligence concerning the Enterprizes and Designs of *Strangers* against his *State*, to the end, that if he find they intend to break their *Treaties* with him, he may not think himself obliged to keep his. And so to be always ready, either for *Peace* or *War*.

It is a great Argument of the Prince's *Prudence*, to make choice of Wise *Counsellors*, Men Eminent for their *Honesty*, *Great Experience*, *Faithfulness* and *Prudence*. He must also take care, that he be not offended with *Truth*, if any thing be spoke or advis'd by them contrary to his *Mind*; but let him embrace and encourage *Sincerity*, and condemn and hate *Flattery* wheresoever he meets with it.

He ought also to take great heed, that his Officers and *Lieutenants* keep within the bounds of their *Duty*, and that they may not be injurious to any. That those who are the *Governours* of *Cities* and *Provinces*, do not enrich themselves by oppressing of the *Subjects*: That the *Chief Commanders* of his *Army*, keep their *Souldiers* within the bounds of due *Discipline*, not suffering them to violate the *Martial Laws* without present Punishment: That the *Judges* exercise *Justice*, and render to every one what belongs to them. Of all which things, I have handled at large in my Treatise of the *Best Government*, to which I refer my Reader.

But forasmuch as the *Duties* of a Prince do relate either to a Time of *Peace* or *War*, we must also treat of them in particular. His first *Duty* therefore in Times of *Peace* is, that he take care to promote the Honour of *GOD*, and encourage *Religion* and *Godliness*, and suffer no Innovation in Matters of *Worship*. By which means he will have *GOD* to favour him in all his Undertakings, and will engage his *Subjects* to have a great Esteem and Veneration for him.

V.
A Prince ought to be well acquainted with the Nature of his Kingdom.

VI.
A Prince ought to be well informed with what passeth in Foreign Countries.

VII.
A Prince stands in need of Faithful Counsellors.

VIII.
A Prince must have an Eye to the Administration of his Chief Ministers and Great Officers.

IX.
The Duties of a Prince in time of Peace, is to take Care of Religion.

In

X.
To encourage
Arts.

In the *Second place*, he ought to be careful in encouraging and promoting all *Arts*; not only those which are furnamed *Liberal* or *Ingenuom*, and which are of great Advantage and Honour to the *Government*; but others also, which we call *Mechanical*, and especially those that are of greatest use to the *Commonwealth*, and bring the greatest Profit and Riches to the *Kingdom*; as are those of *Agriculture* and *Navigation*, whereof the former furnisheth his *Subjects* with the *Necessaries* of Life; and the latter carries on *Trade* with *Foreign Nations*, and is a means of enlarging his *Dominions*, and bringing *Treasure* to his *Coffers*. And what is more, *He that is Master of the Sea, may in some sense, be said to be Master of the Land also.*

XI.
To keep
and per-
form his
Treaties
faithfully
and punc-
tually.

Thirdly, A *Monarch* must be careful to observe the *Peace*, and other *Treaties* he hath made with other *Nations*, so as never to suffer the same to be violated. For nothing is more shameful or hazardous to a *Sovereign*, than to break his *Word*; because by this means he teacheth his *Subjects*, upon occasion, to serve him after the same manner, and to revolt from him.

XII.
To have an
Army al-
ways in a
readiness.

Fourthly, He must make it his business to be always provided of a good *Army*, to prevent the *Faction* of any of his *Nobles*; or to suppress the *Conspiracies* or *Rising* of any other of his *Subjects*. I understand by *Faction*, a *Company* of *Seditious Persons*, which have united themselves for the carrying on of some design, without the permission of him who governs the *State*.

XIII.
To curb all
Ambitious
and Aspi-
ring Spi-
rits.

He must also be mindful to curb and restrain *Ambitious persons*, and such who have a disposition to *Rebel*, and to put the *State* in confusion. For seeing that there are in all *Governments*, *Persons* who suppose themselves more wise and able to manage the *Publick Affairs*, than those who are charged with them, they will not be wanting by all manner of ways to defame and reproach their *Conduct*; and not finding their *Ambitious desires* satisfied in the present state of *Affairs*, would be ready to overthrow the *Settlement*, if the *Prince* were not always in a readiness to oppose and crush their *Designs*.

XIV.
To restrain
Factions.

Fifthly, In case it happen so, that he be not in a condition, to break the grown *Faction* in his *Kingdom*, that then he make use of *Men* esteemed for their *Piety* and *Worth*, before that he have recourse to *Arms*, that by their *Authority* and *Favour* they may appease the *Minds* of these *Mutineers*, and bring them to *Reason*. And in case they are stubborn, and will not acquiesce in their *Reasons*, nor give ear to their *Exhortations*, that then he resolve to vindicate the *Contempt* of his *Authority* by force of *Arms*, and to crush the *Rebellion* in the *Egg*, lest being grown strong, it prove troublesome to him, and render the *Sore* incurable. To this end it will be very conducive, if the *Sovereign* take care, by all means, that his *Subjects* may be eminent for *Vertue*, and abound with *Riches*, and be plentifully stored with all the *Conveniences* and *Necessaries* of *Life*, but yet without *Excess*. For as *Physicians* tell us, that *Diseases* are caused by *Intemperance* or *Excess* in *Eating* or *Drinking*: So the *Corruption* of *Manners*, the *Contempt* of the *Laws*, and the *Insolence* of the *People*, is often caused by the too great affluence of *Riches*; except the *Prince* takes

care to prevent it, by engaging the *Rich* to contribute liberally to the *Necessities* of the *Poor*, and by the abundance of their *Wealth*, relieve the *Wants* of their *Indigent Neighbours*.

But because the *Sovereign Majesty*, as *JUSTINIAN* saith, must not only be armed with the *Laws*, but also fenced with *Arms*, that he may be in a condition to govern his *Kingdom* successfully in times of *War*, as well as *Peace*; he is to take care, that he do not engage himself in any *War* rashly, nor indeed without urgent *Necessity*. As a *Physician*, who hath no recourse to actual *Cauteries* or *Amputation*, till he hath in vain attempted all other *Means*: Whether therefore a *Prince* design to engage himself in an *Offensive War* against any, or that he resolves only to be on the *Defensive*, he ought to make an exact estimate of his *Force*, and duly consider whether he be in a condition to execute the *Exploit* he intends, or to resist the *Force* of him that attacks his *State*. For if he find himself too weak for his *Adversary*, it will be great *Imprudence* for him to attack his *Enemy*, lest by being worsted, he give an occasion to his *Adversary* to *Invade* that rightfully, which before he could not do without great *Injustice*. Wherefore in this case, it will be his *Wisdom* by *Mediation*, to prevent the *Invasion* of his *Enemies*, and chuse rather to lose something of his *Right*, than to hazard the *Loss* of his whole *Kingdom*. For *Right Reason* teacheth a *Man*, to seek for *Peace* by all possible means, and that he never ought to prepare for *War*, till he find that there is no hopes of obtaining a *Just* and *Honourable Peace*. But on the other hand, when a *Prince*, after extreme *Provocations*, hath taken up *Arms*, and driven the *Invader* out of his own *Kingdom*, let him enter that of his *Enemy*, and endeavour to make them repent of their *Folly*, and bring them to *Reason*: But yet so, as that he may do nothing contrary to the *Requirings* of *Religion* and *Reason*.

After that he hath gotten the *Victory*, let him take care to spare the *Innocent*, and those who have not shewed themselves *Inhuman* and *Cruel* in the *Wars*. It is the part of a *Man* of *Valour*, saith *TULLY*, to look upon them as *Enemies* who contend for the *Victory*, but to consider those that are *Conquer'd*, as *Men*; to the end that *Valour* may put an end to *War*; and *Humanity*, on the other hand cherish and promote *Peace*. Whereas, on the contrary, it is perfect madness to destroy those *Things* or *Persons*, that do not diminish the strength of the *Enemy*, nor increase that of the *Conquerour*: For he who thus inconsiderately and barbarously wastes all before him, doth not look upon the things he destroys to be his own, but to belong to another.

XV.
What are
the Duties
of a Prince
in reference
to War.

XVI.
What a
Prince is
to do after
Victory.

CHAP. XXXVII.

Of the Duties of Citizens.

MAN is so great a *Lover* of *Society*, and doth so much delight in the *Company* of such as are like him, that he can scarcely frame himself to live alone. But forasmuch as *Society* cannot be long preserved without *Peace*; and *Peace* is the *Fruit* of *Union*, and *Union* supposeth *Order*; *Order*, *Distinction*; *Distinction*, *Dependance*; and *Dependance*, *Authority*: Hence it came to pass,

I.
Whence
Cities had
their Rise.

K k k k

that

THE
SECOND PART,
VIZ.
The History of Nature:
IN NINE PARTS.
Which Illustrates the
INSTITUTION,
And consists of great Variety of
EXPERIMENTS,
Explained by the same
PRINCIPLES.

The

TO THE
Most Noble Princess,
Frances Teresa Stuart,

Dutchess Dowager of *Richmond* and *Lenox*,
Countess of *March*, *Litchfield* and *Darnley*;
Baroness of *Leighton*, *Bromswold*, *Newbury*, *Torbolton*
and *Metheuen*:

Lady *Abigny*, and *Grandessa* of *Spain*, &c.
Descended of the Most Illustrious and Ancient Family
of *Stuart*, and House of *Blantyre* in the Kingdom
of *Scotland*.

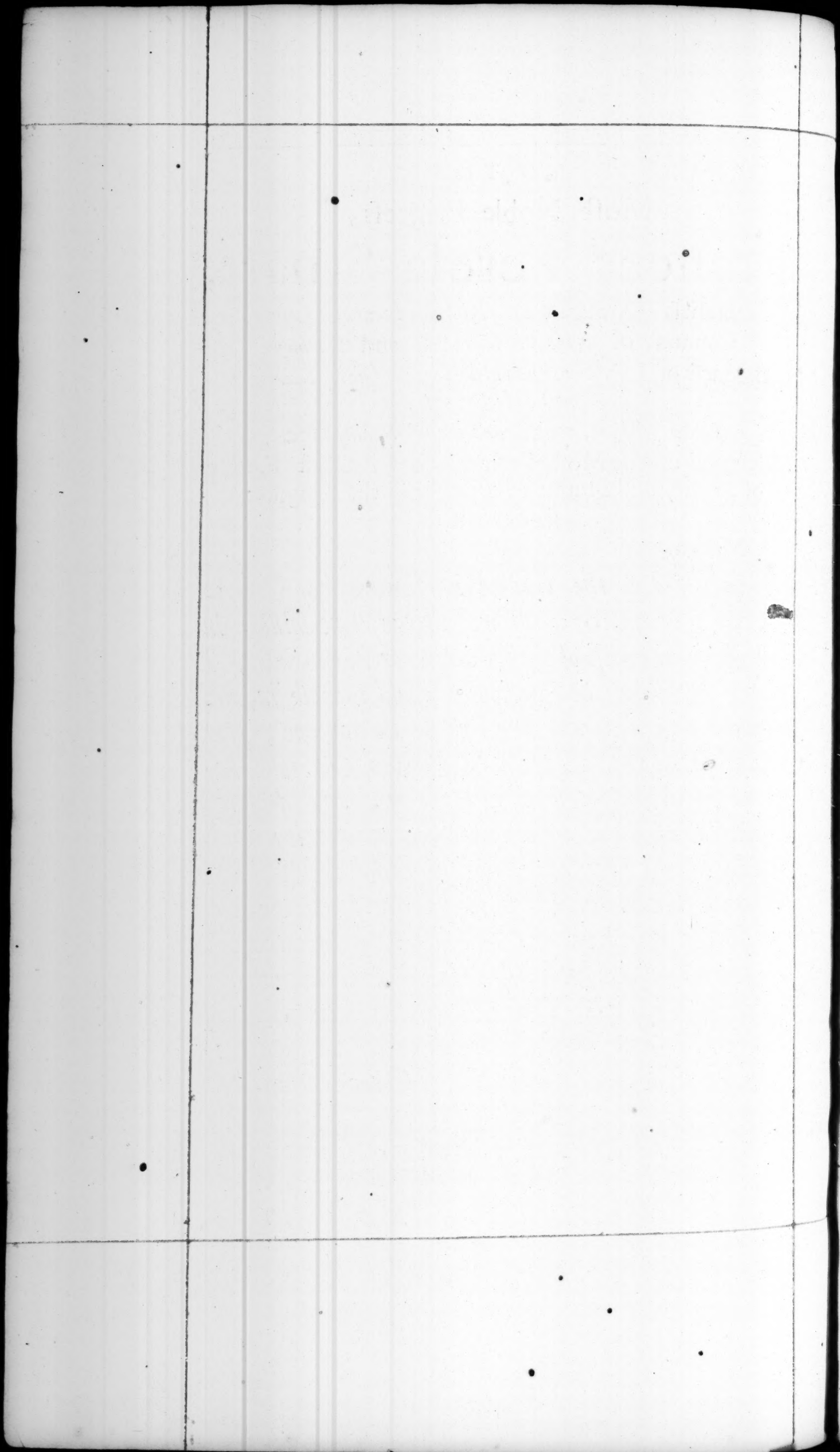
Madam,

T IS the Custom in EPISTLES DEDICATORY to make large *Encomiums* in Praise of their Patron or Patroness; I have as Spacious a Field to walk in, and as much to say in your due Praise as any one; But having found that all such Addresses (by your Generous Soul) are stiled Flattery, and declared displeasing to You, I dare not more attempt it: Only Madam, give me leave to acknowledge the many Favours I have received by your Encouragement of my former Books; and in acknowledgment thereof, I have taken the boldness to select Your Grace the Patroness of this Treatise of the HISTORY of NATURE, and shall be proud of the Honour to have permission to lay it at Your Graces Feet, and to be stiled,

Madam,

The Humblest of Your Graces Servants,

RICHARD BLOME.







The First Part OF THE HISTORY OF NATURE. OF BODIES.

CHAP. I. Of a Body Extended.

I.
The Existence of Bodies is evident to our Senses.

THO' our Senses are often mistaken, and being deluded by false Representations, do circumvent our Mind; yet have we no safer way by which we may arrive to the Knowledge of Corporeal things, than when with their assistance we measure their Dimensions, and by Signs conveyed through our Eyes, discover their Existence: For it is by their Advertisements we come to know, that Matter consists of 3 Dimensions; and that the Parts of it are capable of various motions, have different Forms, and do diversly affect the Organs of our Senses. For tho', it may be, what is presented to our Eye, be only such in outward Appearance, and be represented to us quite otherwise than indeed it is; yet must not we therefore suppose it to be no more than a Phantasm, or some vanishing Appearance, and such as is not to be ranked in the Catalogue of Things; seeing it is necessary that something that is Bodily, must lye hid under that shell or outward Appearance, and which really is the basis and foundation of the Figure we see; tho' because of its distance, or for other Reasons, it may not be perceived such as indeed it is, but takes to it self another Appearance, that it may arrive at the Organs of our Senses.

II.
The Senses are not deceived, as to the Matter or Subject of things.

There is no question, but that he to whom a Square Tower, viewed at a distance, appears to be Round, hath something that is Material or Substantial conveyed unto his Organ; since it is impossible that either a Square or Round Figure should be seen, without any thing to support it, or that might be the Subject of it; it being a plain Contradiction, that a Mode should be taken from Matter, and exist without it: For indeed if we well consider the Nature of a Mode, we shall find that it cannot so much as be in our Thought conceiv'd as separated from it. For tho' we can have a clear perception of Substance, whether Material

or Immaterial, without their Modes; yet by no means can we conceive those Modes, without the said Substances, since it is their very Nature to affect and diversifie Substances.

Wherefore the Ancient Philosophers did demonstrate, that a Body consists of a concurrence of Figure, Magnitude and Resistance; because they found nothing but Matter was extended in Length, Depth and Breadth; nor any other thing besides it, that could not abide its like in the same place with it, but pulseth it thence, and excludes Penetration. For herein do Material Substances differ from Spiritual, because the former fall under our Senses, carry a bulk with them, and are subject to the Touch. By the word Touch, we do not only understand the Sense so called, which is peculiar to Animals, and whereby they feel External Bodies; but that more general, whereby 2 Bodies touch one another with their Surfaces, and whereby they are intimately close to one another. For it is the property of Material things, only, to touch and be touched, and to be joyned together by a kind of middle Term; which is so evident, that it cannot be question'd by any that either make use of their Imagination, or perceive any thing by the Senses: As LUCRETIVS in his First Book tells us,

*That Bodies are, we all from Sense receive,
Whose Notice, if in this we disbelieve,
On what can Reason fix, on what rely?
What Rule the Truth of her Deductions try,
In greater Secrets of Philosophy?*

But some it may be will object here, that a Spirit also is Extended, and yet is excluded from participating of the Nature of a Body. To which I Answer, That when a Spirit is said to be extended, this is not to be understood according to the threefold dimension of Bodies, which we imagine; but with respect to its Power and Energy, whereby a Spirit diffuseth its active Force, sometimes through a larger, and at other times through a lesser part of the Bodily Substance; so that in case there was no Body or Space, a Spirit could

LIIII

never

III.
The Opinion of the Ancients about the Nature of a Body.

IV.
How a Spirit is said to be extended.

V.
Whether
there be
any Vacu-
ties in
Bodies.

never be understood to be *extended*, that is, to have, or correspond with any dimensions.

The only *difficulty* that remains to be resolved, is, whether besides the *Bodies*, whose Nature, we have said, doth consist in *Extension*, there be any *Vacuity* in *Nature*, destitute of all *Matter*, which yet enjoys the properties of *Longitude*, *Latitude* and *Profundity*. GASSENDUS, who hath made it his business to restore the *Doctrin* of EPICURUS, and hath made himself Famous by raking these *Emptinesses* out of the *Darkness*, wherein they had for many Ages been buried, in his *Animadversions* upon the *Tenth Book* of LÆRTIUS, concerning EPICURUS his *Physiology*, doth both by *Reasons* and *Experiments* endeavour to prove, that there are *empty Spaces* in the *World*; which tho' they do not actually contain any *Body*, yet are so dispersed amongst *Bodies*, as to be ready to admit *Bodies* and contain them. Much after the same manner, as a *Vessel* is said to be *Empty*, when it is destitute of any *Liquor*, which yet it is capable of receiving. For if this *Liquor* chance to be emptied out of the *Vessel*, the inward Surface of the *Vessel*, which before contained the *Liquor*, must needs remain *empty*; except some other foreign *Matter* come in to fill up its sides, and be commensurate to the Dimensions of the *Body* that fill'd it before. He confirms his Opinion by the Example of a *Heap of Wheat*, betwixt the *grains* whereof many *little spaces* intervene, which are not taken up by them, forasmuch as their *Surfaces* appear to the *Eye*, to be distant from each other, it being impossible they should lye so close together, but that they must leave some *Intervals* destitute of any *Bodily Substance*.

VI.
A Physical,
and a Mathe-
matical
Body do
not differ.

But GASSENDUS doth not seem, in this his Assertion, to have warily enough consider'd the Nature of a *Body*, which doth not only consist in a *Physical* or *Natural*, but also in a *Mathematical Extension*; and which is of that intimacy to it, that it cannot so much as in *Thought* be separated from it. So that *Extension* is Reciprocal with a *Body*; and as there is no *Body* which doth not consist in *Length*, *Breadth* and *Depth*; so there is nothing commensurate to those 3 *Dimensions*, but hath also the Nature of a *Body*.

VII.
The Di-
stance that
is between
Bodies, or
the parts
of a Body,
do not
prove a
Vacuum.

But some will say, We find *little Spaces* betwixt the *particles* of *Bodies*, which because of the diversity of their *Sides* cannot be filled up by them. I grant it; but will it follow from thence, that those *Intervals* or *Spaces* must therefore be *Empty*, or destitute of any *Bodily matter*? For why may they not be fill'd with *Air*, or some other *Matter* more subtil than it? For if the said *Parts* be distant from each other, and take up *different places*, how can they be conceived to be distant, or truly said to be so, by means of an *Empty interval*? Seeing that according to that Saying amongst *Naturalists*, *Something must always intervene between those things that are distant*. For, seeing that *Distance*, which cannot be found but between things more than one, is a kind of *Relation*; and that every such must have a *Foundation*, it is necessary that the said *Relation* rest on a real ground or basis: Forasmuch as a *Non-entity* hath neither *Affections* nor *Operations*; and consequently, that which is *Nothing* can never constitute the *Distance* of *Bodies*.

Neither must we assert with some, that *Distance* is founded in the *Bodies* themselves, that are distanc'd from each other, and that *Possible Repletion* is sufficient to constitute it. For from this Supposition we might lawfully infer, that they are at a *Distance* from one another, which way soever they are posited or disposed, seeing that the same *Foundations* do still remain, whether they be distant, or touch one another. Wherefore *Distance* must be assigned to something that is different from the *Bodies* themselves; which seeing it cannot be *Immaterial*, for that it is unextended, we must have recourse to something *Corporeal* that must be the Cause of it.

I know very well, that some *Philosophers* do not approve of our assigning triple *Dimension* to be a *Substance*; they looking upon it to be no more than a *Mode*, or *Accident*. For who doth not consider the *Extension* of a *Stick*, to be only a *Mode* of it, and that the *Stick* is the *Subject* or *Substance* which supports it? But it will be ealie to shew, that this *Error* is only deriv'd from our common way of expressing our selves; and that it is every whit as absurd to assert it, as if a *Man*, hearing some speak of the *Royal Palace*, should imagine these 2 words to mean 2 things, and that one of them was a *Mode* of the other. But to the end, that all the difficulty we meet with in this business may be cleared out of the way, we shall only take notice, that such is the Nature of a *Substance*, that it can exist without a *Mode*; whereas a *Mode*, on the contrary, doth so depend upon *Substance*, that it cannot exist without it. Now it is apparent, that the *Extension* in a *Stick*, can be without a *stick*, seeing that there are many *Bodies* that have not the Form of a *Stick*, which notwithstanding have *Extension*; but there can be no *Stick*, which is not *extended*. And therefore it is so far from this, that *Extension* can be said to be the *mode* of a *Stick*; that we must rather conclude, that *Extension* deserves the Name of *Substance*, and that the Being of a *Stick* is only the *Mode* of it.

Hence it is apparent how foolishly they Talk, who consider *Mathematical Points* in an *Extended Substance*, and will needs have the divisibility of it to be bounded by an indivisible Term or Boundary. For if in any *Line*, by *division* we come to the last Indivisible; that being once taken away, if you divide the other *Parts* after the same manner, you will at last come to the like indivisible or unextended *Terms*; and afterwards having made a like *division* of all the rest, you will find nothing else in this *extended Line*, but *Indivisible* or *Mathematical Points*: Which is not only contrary to *Reason*, but also destroys the Notion we frame of *Extended Beings*.

But the *Epicureans* will Object, That the last Resolution of *Natural Compounds*, is into the least *Natural Bodies* or *Atoms*; for that otherwise every *Body* would be divisible into *Infinite*, which they suppose to be an Absurdity. For that every thing which is *Divisible*, can only be divided into those *Parts*, which are *actually* in it; and consequently, that if *Bodies* be infinitely divisible, they must have *actually infinite Parts*: And so all *Bodies* will be *actually infinite* in their *Extension*, which no *Man* in his Wits will undertake to assert.

I intend

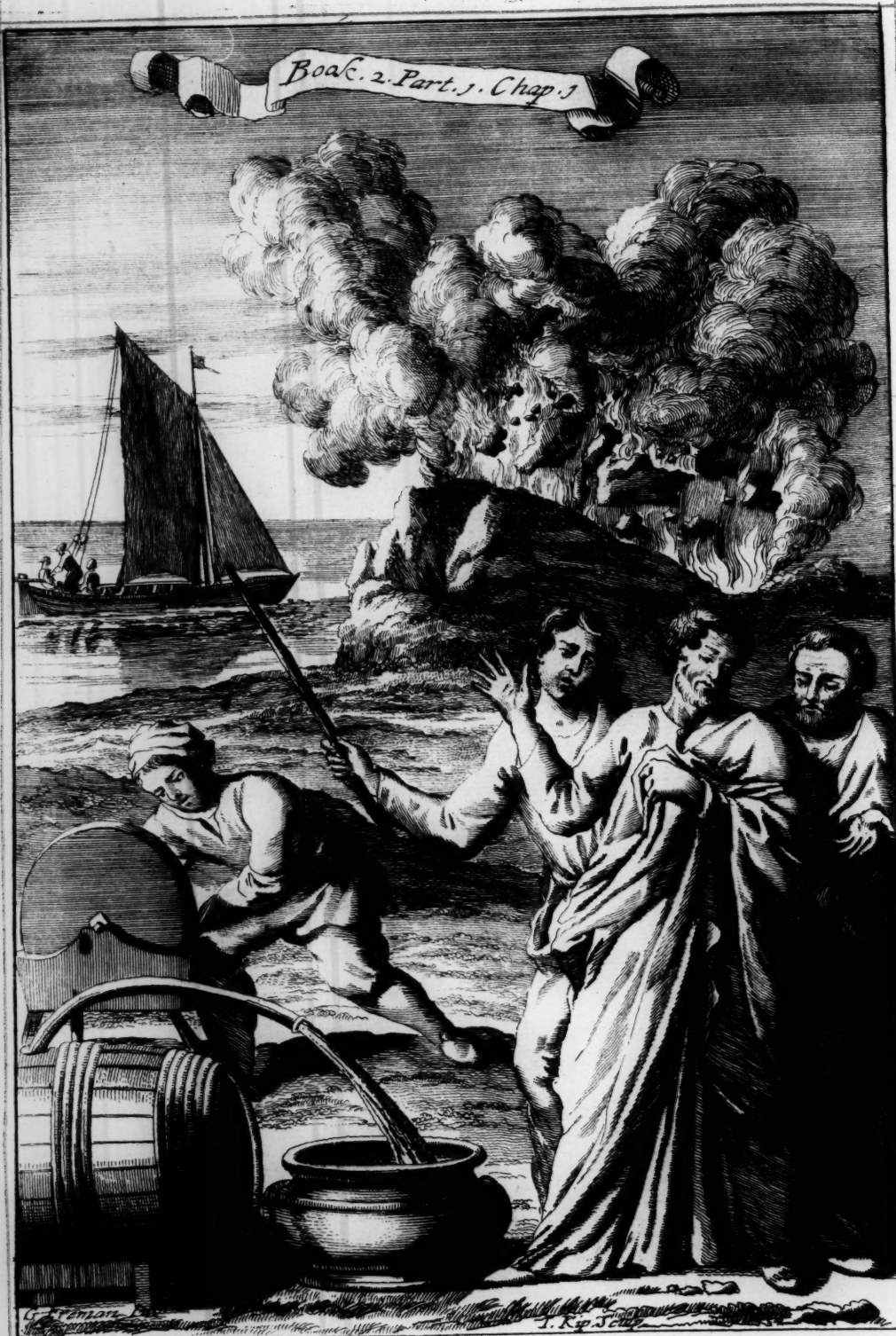
VIII.
Possible Re-
pletion is
not suffi-
cient to con-
stitute
Distance.

IX.
Extension
is that
which
constitutes
material
Substance.

X.
Nothing
that is in-
divisible
can be con-
sidered to be
in a Body.

XI.
An Objecti-
on of the
Epicureans.





XII.
A Physical Atom, or least Body, is indivisible, because it consists of Parts.

I intend to give a full Answer to this Objection, in the Fourth Chapter; but shall here demand of these Defenders of EPICURUS, whether an Atom, which they contend is Indivisible, have any parts; or whether it be destitute of all parts, and consequently of Extension? If they affirm the latter, then their Atom doth not differ from a Mathematical Atom. If they affirm the former (for it cannot be denied, seeing that every Atom is endued with triple Dimension, and hath its particular Figure) it is obvious to enquire, whether the parts of an Atom consist of other less parts, and so on to Infinity; or whether at last we must come to the least parts, which admit of no further Division. If they maintain this, they embrace the Opinion of ZENO, and so will be bound to maintain and defend a Mathematical, and not a Physical Atom, which indeed is no better than a meer Fiction; but if they chuse rather to maintain the other, there is nothing in Bodies that is altogether indivisible, nor any Atom, whether it be called Mathematical or Physical.

XIII.
GOD can divide a Physical Atom.

Besides, an Atom cannot be conceived to have a Figure, and several Angles really and intrinsically different from each other; for if so, it could not be Indivisible, and consequently no Atom. For is it not evident, that all those things that can be conceived by different Ideas, and that have a real independent Existence, can also be divided and separated from each other? And cannot the Infinite Power of GOD, at least, do as much as our Finite Intellect can conceive? Now our Understanding can conceive 2 Angles of the same Atom under several Notions, and know one of them without knowing the other; and conceives also that several Angles of the same Atom do subsist independently of each other; and therefore it is not to be question'd, but that GOD, by his Omnipotence, can separate these Angles from each other.

CHAP. II.

The Arguments of EPICURUS Answer'd, whereby he endeavours to prove, That there are empty Spaces interspers'd between Bodies.

I.
The Rest, or Motion of Bodies, does not require an Empty Space.

EPICURUS, who confounds Place with a Vacuum or Empty Space, and supposeth that all Bodies have their residence in those Vacuities, is of Opinion, That except there were such, Bodies would have no places to exist or move in. For since a Place is commensurate to the thing placed, and the hollow Surface of that, must be equal to the outward Surface of this: As also, that Place is accounted Immoveable, and that it is repugnant for it to be removed from its position; it follows that Place must always continue the same, even after that the Body, which fill'd it before, is removed elsewhere, and successively takes up other Places; and that therefore it is necessary, that the same be left Empty, and do preserve its Parts immoveable.

II.
Bodies, where they come, bring their places along with them, and

But EPICURUS was mistaken, in that he suppos'd a Place to be a Space subsisting of it self, which is equal to the Body placed, in Magnitude, and really distinct from it: For if we precisely have regard to the Notion of a Place, we shall find it

to be nothing else, but a certain Respect of the Situation of a Body, to the Neighbouring Bodies about it; or to others more Remote, from whence it takes its immobility. So that to say a thing is in a Place, or acquires a new Place, is no more than to say, that it attains or acquires such a Situation, with respect to other Bodies. And it is a meer Mistake of the Mind, to imagine a Place to be a certain Capacity or Interval, which Bodies enter into, and leave again; forasmuch as Bodies do indeed bring their places along with them, and upon their Removal take them away again. And therefore we say, that a Body takes up some space, forasmuch as it is of such a Bulk amongst the other parts of the Universe, and is ranked amongst Material things: And that it quits a place, when it ceaseth to keep its Magnitude, Figure and Situation between such and such determinate Bodies.

upon their Removal take them away.

Another Argument, whereby EPICURUS endeavours to establish a Vacuum, is taken from the Nature of Motion. If, saith he, there be no Empty space in Nature, neither is it possible that there should be any motion; and consequently the whole Universe would be nothing else, but a stiff immoveable Mass, and unable to admit any Bodies into it self. For supposing all Spaces to be full, a Body will be incapable of removing it self from one place to another, but by thrusting another out of its place; so that if we suppose any Body to be moved, it must of necessity thrust another, at least of equal bigness with it self, out of its place; and that also must do as much for another, and so it will be necessary to allow a Process to Infinity, except that some Empty spaces be allowed, into which the Bodies that are in Motion may enter, and, as it were, take up new Lodgings.

III.
Whether there can be any Motion, without allowing an Empty space.

This Argument of EPICURUS might be of some force, if there were no other motion, but that which is made in a straight Line; and if when one part of the Matter is moved, the other following were moved for ever; but daily Experience teacheth us the contrary, and that indeed there is another Motion, that is, a Circular, by which a Body, when it is made, doth drive another out of its place, and that again another and another, till it come to the last Body, which enters the place of the Body that was first moved. Now this Circle can be performed without the supposal of any Vacuum. As suppose we the hollow Circle XYZ, fill'd with 12 Bullets, whilst the first of them A moves, it pusheth on the second B, and that the third, till by continual pushing, the place which was left by the first Bullet, be fill'd by the last Bullet C. And thus we see how motion may be without granting any Empty space, to which Bodies might betake themselves.

IV.
In every Motion, a whole Circle of Bodies moves together.

If you Object with GASSENDUS, that the Bullet A cannot move, except the twelfth Bullet C be moved also; and that C cannot move, because, in order to its motion, it is necessary that A do possess the place of B, which as yet is not conceived to be empty, and that therefore as long as B continues unmoved, neither can A be moved; and that consequently all the Bullets contained in the Circle will continue unmoved.

Figure 1.

V.
An Objection against the Circular motion of Bodies.

I An-

VI.
The Objection Answer'd.

I Answer, That this Objection of GASSENDUS is built upon a false *Supposition*, whilst he imagins that the *Bullet C* cannot move, except there be some *Empty Space* whereto it might betake it self, when it begins to move; since it may so happen, that at the same *moment* when A enters the place of B, C may leave its former place; so that whilst the *Bullet A* passeth towards B, it pusheth B forwards, and B that which is next to it, &c. unto C, which at the same instant enters the place left by A.

The thing will be more evident in a *Grind-stone*, or in an *Iron Circle*, which is moved about its own *Center*; for since every part of it doth at the same instant possess the place which is quitted by the fore-going, we see there is no necessity to have recourse to a *Vacuity*. For if this may be done in an *Iron Circle*, why may it not as well be done in another, partly consisting of *Wood*, and partly of *Air*? Why may not the *Body A*, which we suppose to be *Wooden*, push the *Body B*, which is *Airy*, out of its place, and B again that which is next to it, and that again another till it come to C, which will take up the place of A, at the very same time that A quits it? The same may be illustrated by the *Circling* of the *Water* about a *Ship* under *Sail*.

VII.
Why Water sometimes mounts upwards.

Accordingly we find, that as much *Liquor* as runs out of any *Vessel*, so much *Air* must of necessity enter into it; and except there be an open vent for the *Air* to enter, it will be in vain to endeavour to draw the *Liquor* out of the *Vessel*; because wherever this *Circular motion* is hindred, it is impossible for a *Body* to remove out of its place. Thus when the *Air* is drawn out of a *Pipe*, the other end whereof stands in the *Water*, the *Water* immediately mounts upwards, notwithstanding that that *motion* is contrary to its *Gravity*.

VIII.
All Bodies move together, tho' it be in an Unequal Circle.

And that it happens thus in every *Circle*, is easie enough to be conceived, especially where this *Circle* is supposed to be perfect, so that all its *Parts* are at an equal distance from the *Center*. But the same doth not seem to happen where the *Circle* is unequal, and whose *Spaces* are different in breadth and narrowness, as appears in the *Circle EFGH*. But this Difficulty is easily solved, if it be consider'd that all these *Inequalities* may be compensated or made up by swiftness of *motion*. For suppose we the *Space G* to be 4 times broader than the *Space E*, and double as broad as the *Space F* and *H*, it must necessarily follow that the matter must move 4 times more swiftly at E, than at G, and twice as swift at F and H; and thus, because the swiftness of the *motion* makes amends for the narrowness of the *place*, there will in the same *Space* of *Time* as much Matter pass through one part of the said *Circle*, as through the other: So that there is no necessity at all to feign *Empty Spaces*, or to admit of *Condensation*.

IX.
It is not necessary, that all Motion should be Circular.

But when we say that *Bodies* move in a *Circle*, we must not be so understood, as if we supposed that all *motions* were either *Oval*, or perfectly *Circular*; but only that they are called *Circular*, because the last *Body* which is moved by the impulse of another, doth immediately touch the First Mover; tho' the *Line* which is described by all the *Bodies* that are moved, by the *motion* of that one *Body*, be very crooked and irregular.

From what hath been said, an account may be given of that Experiment so common with Boys, viz. how it comes to pass that a little round piece of *Leather* is able to lift up a great *Stone*; the Reason whereof is, because the *Stone A*, hanging on the *String B*, by means of the *Leather C*, to which it cleaves or sticks fast, cannot fall down from the *Leather*, without the *Air* that is under the *Stone* be first driven out of its place, and come into the place of the *Stone*, under the round bit of *Leather*: But forasmuch as before the *Stone* can fall down from the *Leather*, there must be a *split* or opening between the *Stone* and the *Leather*, before there comes to be a greater *Interval* between them, capable to receive or admit the *Air*, as being thicker and more expanded, because of the intercurrent *Aethereal Matter*; it so happens, that because the *Circle of Bodies* is hindred, the *Stone* of necessity must stick so long to the *Leather*, till the *Air* be driven away from under the *Stone*, and get in betwixt the *Leather* and the *Stone*.

X.
How it comes to pass, that a little round piece of Leather, when it is able to lift up an heavy Stone.

Figure 3.

The Difficulty we have to conceive the *motion* of *Bodies* where there is no *Vacuum*, proceeds from a *Supposition* we have taken in, that *GOD* at the Beginning divided *Matter* into *Equal parts*, *Round*, *Square*, *Triangular*, &c. According to which Conceit, we cannot imagine how possibly they could move, without leaving *Empty Spaces* between them. And indeed, granting this *Supposition*, it could not be otherwise: But indeed we must go upon a quite contrary *Hypothesis*, and conceive that *GOD* at the Beginning, divided the *Matter* into *Unequal parts*, infinitely differing in *Bulk* and *Figure*; which supposed, it will be easie to comprehend that a *Body* may move where there is no *Vacuum*, but all full of *Bodies*, as well as in a *Vacuum*; for let it be *Square*, *Round*, *Oval*, or of any other *Figure* whatsoever, the *Spaces* which are between it, and the *Bodies* that surround it, will not be empty, because there will be always *Particles* of *Matter* *Subtil* enough for to enter and fill them, and besides will be endued with sufficient agitation to break them; and by breaking of them, reduce them to *Figures* proper to fill the places they are to enter.

XI.
Whence the Difficulty we have to conceive the Motion of Bodies, in a Space full of Bodies, doth arise.

CHAP. III.

GASSENDUS his Experiments examined, whereby he endeavours to prove, that there are *Vacuities* in *Bodies*.

There is no question, but that *Experiments* are the best Proofs of *Philosophical Truth*, and that those *Principles* are most likely to be true, which are built and founded upon *Natural Phenomena*, and have them to be the *Witnesses* of their Evidence. And therefore it is that GASSENDUS endeavours to prove the *Existence* of *Empty Intervals* in the *World*, by *Arguments* drawn from *Condensation* and *Rarefaction*. Suppose, saith he, a *Wind-Gun*, and that the *Bore* that contains the *Air* is of the length of 2 *Fingers*; there is no question, but that as much of the *Air* is therein contained (if no *Empty Spaces* be interspersed between the *Parts* of the *Air*) as the *place*, or capacity of the *Bore* is able to contain; so that there is no part of the *place* so little, to which a part of *Air*, of equal Bigness, doth not answer, and consequently

I.
Gassendus, his Experiment drawn from a Wind Gun, to prove a Vacuum.

sequently the parts of both must be equal in Number.

Suppose also this Number to be 1000, then let the Air be compressed with an Instrument fit for that purpose, and by that means be reduced to the measure of a Fingers length only. What order will these parts of Air afterwards keep, when at that time, of the parts of Place, there are not above 500 left? Or shall we suppose that 2 Bodies are crouded into one and the same place? This is repugnant to the Laws of Nature, since Impenetrability is the Property of a Body; and it is as much a Contradiction for 2 Bodies to be in the same place, as for 1 Body to be in divers places. Wherefore if the Particles of Air, contained in the Bore of the Wind-Gun, be shut up in a more narrow place, it is necessary that their Sides and Angles should be more closely lodg'd, and fill up the Intercepted Empty Spaces; which being once fill'd, it cannot be thought strange, if by this means the Interval be made so much the lesser, and less protuberant than it was before.

But GASSENDUS in alledging this Experiment, doth not seem to have heeded the Proceedings of Nature; for tho' naturally Penetration be repugnant to Bodies, yet must not we infer from thence, that there are Empty spaces in Bodies, which may receive the ambient Air, or contain any other Matter; seeing that it is very possible, that amongst the thicker parts of Air, there may be some more Subtil matter, which coming forth from the Pores of Bodies, may make that the Space which seems to be fill'd, may admit other Air. Because the Air that is thrust in by force, doth drive out the Subtil matter; which giving way to it, doth break forth through the Pores of the Gun. Wherefore the Compression of the Aery parts doth not proceed from the filling of the Empty spaces, but from the Expulsion of the Subtil matter, which gives way to the parts of Air; whilst they come nearer together, and either make the Pores less, or quite take them away.

For this is a Consequence which is deduced from the Nature of a Body or Matter, that when a Body appears under a less Bulk than it seemed to be of before, tho' it doth not appear that any part hath been taken away from it; we must conceive that some very Subtil matter is come forth from the Pores of that Body, and thereby have made the Parts come closer together, and reduced the whole Body to a less compais.

The next Experiment produc'd by GASSENDUS, is that of an Aeolipile, which is an Instrument made of Copper, or of some other Metal; the whole hollow whereof is at first fill'd with nothing but Air, which becomes so dilated by being set near to the Fire, that the greatest part of it, breaks forth from it through the Hole D, which Hole is afterwards plung'd into a Vessel full of Water; and as the Air of the Aeolipile becomes condensed again by the Coldness of the Water, the Water riseth to fill it. This being done, care is taken so to place the Aeolipile, as that the lower part of it may rest upon glowing Coals, which causeth the Water that is contain'd in it to be rarefied into Vapours, the first whereof being push'd on by those that follow them, make their escape together with the Air through the said Hole D, with so much swiftnes, that they pro-

duce a very sensible Wind, which continues to blow continually, till all the Water be evaporated, or that the Heat do cease to rarefie the Water into Vapours.

Let us suppose therefore the Aeolipile A B C D E, and one part of it A B C, to be fill'd with Water, and the other A E C with Air: Now the Enquiry is, how it can be, that tho' the Water which is contained in this Vessel being rarefied by the Fire, do break forth with great violence through the Hole of it; yet the whole hollow of the Aeolipile, doth still continue as full of Matter as it was before. For if the parts of Air A E C, and the parts of Water A B C, were equal in number before the Aeolipile A B C D E, was put near the Fire to be heated; the remaining parts, after that some of them have been evaporated, must needs take up more place: And therefore like as a Heap of Dust being tols'd with the Wind, becomes diffused and spread abroad like a great Cloud, because of the Air that is intermixt with the particles of Dust, why may not the particles of the Air and Water contain'd in the Aeolipile, being put into agitation by the little Bodies that have been introduc'd, take up the whole Space, which before was taken up by the intersperst Vacuities?

But to this I answer, that there is no Consequence in all this, because the parts of Water A B C, contain'd in the Aeolipile, are not therefore dilated, because they take up the Empty Spaces, which before were intermixt with the parts of Air A E C; but only because the Aeolipile being set upon the Fire, the heat thereof sets the particles of the Water in motion, and makes them to push against each other, and with great striving endeavour to get further from each other. For the Subtil matter, which hath been introduced by means of the Fire, doth distend and dilate their Pores; so that such as are more closely compressed, and do strive to disentangle themselves, break forth with violence through the Hole D, towards F, and resemble the Blast of Natural Wind. Wherefore the Dilatation of the Water, upon the Surface A C, is only to be attributed to the Subtil matter, which is entred through the pores of the Aeolipile, which agitating the particles thereof, doth not permit them any longer to hang together; according as GASSENDUS himself doth acknowledge in these Words; And this by the Activity of the particles of Fire, which being entred into, and most swiftly tossed between the Sides of the Aeolipile, do not suffer the Parts of the Water to rest; but drives them up and down, this way and that way, so as that they seem to fill the whole Space.

There is yet another Experiment whereby GASSENDUS supposeth that Vacuities are certainly proved: For he considering that a determinate quantity of Salt only could be dissolved in such a Measure of Water, and that having taken in as much as it can, it leaves the rest of the Salt undissolved; this he thinks cannot be solved any other way, than that the Salt being separated into very small particles, doth every way penetrate the Water, and fill the Empty Spaces that are in it; which being done, the further dissolution ceaseth in the same manner, as a Stomach that is already glutted with Food, doth cast up whatsoever is super-added. And forasmuch as the Particles of Salt are not all of one Figure; for those of Common Salt

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VI.
The second Experiment of GasSENDUS against a Vacuum, fetch'd from an Aeolipile.

VII.
The Experiment of the Aeolipile explained.

VIII.
A third Experiment fetch'd from the Dissolution of Salts.

II.
It is repugnant for one and the same Body to be in more places at the same time.

III.
The true Reason of this Experiment given.

IV.
From the Nature of a Body.

V.
What an Aeolipile is.

Figure 50. is the In-situation.

VI.
VII.
VIII.

ATE

are Cubical or Four-square, those of Atom 8 Corner'd, &c. Spaces of a different Figure must be assigned to them; and that there are such, may be easily proved, because *Water* already impregnated with common *Salt*, doth notwithstanding afterwards dissolve and take in *Atom*, *Salt Armoniack* and *Sugar*. Which admission of several *Bodies*, cannot be imputed to any other Cause, but those *Empty spaces* which are between the parts of the *Water*; because when they are once fill'd up, the *Water* can dissolve no more of these *Salts*, as having no *Vacuities* where to bestow them.

IX.
How Salt
is dissolv'd
in Water.

This Experiment would be of some service to GASENDUS, if he could persuade us, that the Bulk of the *Water* is not at all increased by the dissolving of *Salt*, and that it takes up the same Space it did before; whereas indeed daily Experience teacheth us the contrary. For tho' in a Cup full of *Water*, a certain quantity of *Salt* may be dissolved, without spilling any of it, yet not without some spreading of its Surface: For it is evident, that by the putting of *Salt* or *Ashes* into *Water*, the Surface thereof swells, and jets out in the midst, in the manner of a *Globe*. As may be seen in a *Weather-Glass*, or *Glass-Pipe*, into which if any *Salt* be infused, the *Water* presently increaseth and mounts higher.

X.
Why a cer-
tain and deter-
minate quan-
tity of
Water, can
dissolve a
certain
quantity
of Salt
only.

But you'll say, If there be no *Vacuities* in the *Water* to admit the particles of *Salt*, how comes it to pass that it is satiated with a certain quantity of it, and rejects all the rest? This may easily be answer'd, by supposing that the parts of *Salt* are stiff and inflexible, whereof those of fresh *Water* are very soft and flexible. For when the parts of *Salt* lye athwart one another, they give occasion to the parts of the fresh *Water* to run or slide between them, and like Rings to encompass them round, and to dispose them so that they may the more easily glide between them, and continue their motion, than if they were all alone. For the parts of *Water* being entangled with the parts of *Salt*, the *Subtil matter*, by whose force they are agitated, have no other business, but to carry them swiftly round the particles of *Salt*, which they embrace. Whereas, when they are alone, and constitute the fresh *Water*, they are so confounded together, that the *Subtil matter* is forced to employ part of its strength, in variously bending and plying of them; seeing that without the impulse thereof, they continue immovable, and cannot be separated from each other. Forasmuch therefore as the parts of fresh *Water* are finite, and that the virtue they have to move themselves is limited, it must necessarily happen that after they have encompassed a certain number of the parts of *Salt*, they will not be able to overcome the resistance of the rest; and therefore the *Water* being as it were satiated, will not be able to dissolve the superadded *Salt*; because there are no more flexible parts of the *Water*, to surround or embrace the particles of *Salt*, by winding of themselves round about them, and by that means cause a liquefaction of them. This is manifest in *Common-water* and *Aqua-fortis*, which can only dissolve a determinate quantity of *Salt* or *Metal*; so that if after they have received this proportion, if one should but cast in over and above one grain of *Salt*, it will remain as much undissolved, as if it was laid up in a dry place.

XI.
The Reason
of all

And for this Reason it is, that hot *Water* that hath run through *Nitrous Earth*, and thereby be-

come a *Lye*, by having taken in a quantity of *Nitre*, being removed from the Fire, and let rest for some time, many of the *Atoms* of *Nitre*, separated from the rest, begin to cease from motion, and sticking to the inward Sides of the *Vessel*, do constitute the wonderful 6 Corner'd *Bodies*; whence we may easily apprehend all the *Crystallizations* of the *Chymists*, and how they are done.

It remains now only, that we endeavour to assign the Reason of that Experiment, which TORRICELLIUS made at Florence, as GASENDUS informs us; which take as follows: Having taken a *Glass-pipe* of 3 Foot long (according to the description of it in the 17th Chapter of the 5th Part of our Philosophical Institution) 7 Fingers breadth, and 9 Inches long, fill'd with *Quicksilver*, and having stoppt the Mouth of it with his Finger, he dipt it into a *Vessel* with *Quicksilver*, and then found that upon taking away of his Finger, all the *Quicksilver* did not run out of the *Pipe* into the *Vessel*, but continued in the *Pipe* to the height of 2 Foot and almost 3 Fingers breadth, after having made some Vibrations upwards and downwards, and in the mean time leaving the upper part of the *Pipe*, not only destitute of *Quicksilver*, but of any other *Body* whatsoever.

This Experiment, tho' it be highly esteemed by some, as that which seems manifestly to evince a *Vacuum*; yet is it of no account with those who admit pores in *Bodies*, which are penetrable by the *Subtil matter*, and take up those places which are quitted by *Grosser Bodies*. For such is the Nature of the *Matter* of the First Element, that it doth not only pierce *Glass*, but even *Diamonds* and *Steel* it self, and any other hard *Bodies* whatsoever. For tho' *Glass* may seem to be destitute of Pores, yet it cannot be question'd but that it is endued with continual Pores, without any interruption; which is evident from its Transparency. For when it is in fusion and liquid, the *Subtil matter* flowing around all its parts, doth form innumerable pores in them, through which the Globuli of the second Element do enter, and diffuse the Action of Light every where. Where tho' that Space in the *Pipe*, which is relinquish'd by the *Quicksilver*, seems to be Empty; yet nothing hinders, but that it may be fill'd with some very *Subtil matter*, which is not subject to our Sight. Neither was GASENDUS ignorant of this, who in his Explication of this Experiment doth allow, that the *Bodies* of Heat and Cold can penetrate into the Hollow of the *Pipe*. And he holds the same concerning the *Light*, which he owns to be a *Corporeal Substance*, and a very thin and *Subtil matter* which passeth through the Sides of the *Glass*. Wherefore it is without all Reason, that from hence he endeavours to prove *Empty spaces*, seeing that in those Intervals that are fill'd with *Subtil matter*, there is as much room to admit other *Bodies*, as if it were altogether empty, and without any *Body* at all in them.

Moreover who doth not know, that Nothing is not capable of any Properties; but if Fire be apply'd to the upper part of the *Pipe*, we shall find a like Rarefaction to be produc'd there, as we perceive in the *Weather Glass*, and by means whereof the *Quicksilver* is driven downwards. When it is very clear, that there is some true *Matter* there, which is the Subject of this mutation.

Now

Crystallizations.

XII.
The fourth
Experiment, of a
Pipe of
Glass, fill'd
with a
certain
proportion
of Quick-
silver.

XIII.
The true
Reason of
the fore-
said Expe-
riment.

XIV.
That there
is no Va-
cuity in
the Glass-
Pipe.

XV.
How the
Existence
of such a
Subtil
Matter
may be
provid.

Now such a *Matter* as is much more subtil than *Air*, not only *PLATO* and *ARISTOTLE*, but all the ancient *Philosophers* have owned, which enters the pores of all *Bodies*, and intimately insinuates it self into them: For by means hereof the *Juices*, which during the *Winter* season the *Earth* conceals in her Bosom, being agitated upon the approach of the *Spring*, do pierce the pores of *Plants* and *Seeds*; but after that the too great increase of *Heat* hath more dilated the *Pores*, or that the *Cold* hath overmuch straitned them; then the *Juice* either passeth directly through them, or by reason of the narrowness of the *Pores*, cannot enter them at all; and consequently the *Seeds* or *Plants* must dye. So that in the whole *Vegetation* of *Plants*, we meet with nothing, but a motion derived from this *Subtil matter*, and proceeding according to certain Rules: So likewise it is an effect of this *Subtil matter*, that *Glass* taken out of the *Furnace*, and set in a *Cold* place, presently breaks to shivers, because the *Pores* of the outward Parts are sooner shut up by the *Cold*, than those which are more inward; and therefore the greater parts of the *Subtil matter* that are shut up in them, hinder the *Egress* of the rest. Neither probably is there any other Reason to be assigned, why *Glasses* break of themselves. And to this we may likewise add, that it is from this *Subtil Aether*, that *fluid Bodies* are enabled to preserve their *Mobility*, and do presently corrupt, whenever their motion is disturbed or interrupted: For the principal Office of this *Substance* is, to dispose and incline the Parts of *Bodies*, and more especially such as are *fluid*, to the Laws of its motion. Neither can any thing else preserve the certain and natural motions of any *Body*. Conclude we therefore, that nothing hinders, but that the *Subtil matter* may enter through the *Pores* of the *Glasses*, and fill that part of it which the *Quicksilver* hath left.

XVI.
The fifth
Argument,
taken from
united Bo-
dies.

LUCRETIVS seems to have found out a stronger Argument than all the rest, for the Proof of a *Vacuum*, which is this: If two most exactly polished *Bodies* be apply'd to each other, and touch one another, it will be impossible to remove the one from the other, but that at the same Moment the whole Surface of the one would be removed from the whole Surface of the other. For tho', it may be, in one part of the said Surfaces they might be more distant than in another; yet as soon as they began to open, they would no longer in any part touch each other, save in the opposit extrem Line: For otherwise the said *Bodies* could not be smooth and even, but crooked and uneven, which is contrary to this Hypothesis. Which being supposed, let the *Air* move with never so great swiftness, yet it can only successively pass the Space which is from the utmost Edge of the Surface, to the midst of these *Bodies*; and therefore it is necessary, that at that point of Time wherein the *Air* passeth the Edge or Brim, there must be conceived an Empty space reaching to the midst of the Surface of those *Bodies*, which is not filled, but during the Consequent Moments of Time.

XVII.
There are
no Bodies
in Nature,
that are
exactly
polish.

GASSENDUS takes this Argument to be convincing, and that it doth not admit any Answer; but if we well examine what it supposeth, we shall discover it to be false and without any ground. For it supposeth 2 *Bodies* exactly polished, when himself (*Phys. Sect. 1. Lib. 6.*) denies, there can be

any such: For tho' *Marble*, *Iron*, *Wood*, and other such like *Bodies*, in which we can perceive none of the least unevenness, neither by our Touch or Sight, seem to be most exactly polished; yet Reason will tell us, that they must of necessity be very uneven, because all this polishing is the effect either of Grains of *Sand*, or of the Prominencies of *Files*, which cannot but leave Cavities, and consequently an uneven Surface behind them. And therefore it is not at all probable, that there can be found any 2 *Bodies* so even, hard and perfectly polished, as that no *Air* should be intercepted betwixt them. But if ever 2 *Bodies* exactly polished happen to be joyned together, then can they not be separated by pulling the one of them upwards perpendicularly, but it will be necessary to draw the upper *Body* away Sideling, and by this means the separation of these *Bodies* is performed, not in a moment, but successively; so that the *Air* doth not easily and readily succeed in the place that is left by them.

CHAP. IV.

Of the Divisibility of Bodies.

EPICURUS, who asserts that *Material Substance* is compos'd of *Atoms*, and to which he assigns the Rise and End of *Things*; imagin'd that *Bodies* were capable of being divided so long, till at last we come to such smallest *Bodies*, as by reason of their Solidness, do exclude any further division, and by no Natural Force can be any more resolved into Parts, as *AUSONIUS* hath it:

*The Principles of all this Building tight,
Are very small, and such as scape our Sight;
Consisting all of Ranks of Atoms fit,
Which solid are, nor parting do admit.*

I.
Divisibility
is a Prop-
erty that
agrees to
all Bodies.

This Opinion *GASSENDUS* endeavours to defend, deriving his Argument from the Dissolution of *Concrete Bodies*: For as we see, saith he, that Nature resolves *Bodies* into exceeding small *Particles*, and in this dissolution proceeds only to a certain number of them; so we ought to conclude, that Nature doth not still divide *Bodies* smaller and smaller to Infinity, seeing that her Force is bounded, and within a short time becomes exhausted, and ceaseth; and therefore after the utmost of her Activity there must remain *Indivisibles*, and that cannot admit any further Partition.

I know very well, that *GASSENDUS* doth not attribute a *Mathematical* Indivisibility to *Atoms*, but only supposeth them to be Indivisible, because of their Solidity, and the indiscerpible cohesion they have of their Parts; but which way soever *GASSENDUS* may endeavour to explain *EPICURUS* his Sentiment, Indivisibility seems to be repugnant to the Nature of a *Body*. For *Divisibility* is the Property of every *Material Substance*, and so intimate to it, that it doth immediately and essentially follow the same: For if we carefully heed the Conception we have of a *Body*, we shall find it to be something Extended, and Commensurate to 3 Dimensions: But how can it be that that which is Extended, and consists of Longitude, Latitude and Profundity, should not be Divisible? Conclude we therefore, that every *Body*

II.
Gassendus
his Opinion
concerning
the Divisi-
bility of
Bodies.

III.
An Indi-
visible
Body is a
Contradi-
ction.

Body is *Divisible*, and capable of an indefinite *Division*, so as that it can never be exhausted by any Partition whatsoever.

IV. This *Division* is variously demonstrated by *Mathematicians*: We shall give you one Instance, that may serve instead of the rest. Let us suppose parallel Lines A B and C D, and the same as to their length *Indefinite*, and a *Fingers* breadth distance from each other: This suppos'd, the Line E F, which intervenes between the foresaid *Parallels*, and that perpendicularly, must of necessity be a *Fingers* breadth long. Then taking the Point A, of the Line A B, which we will suppose also to be a *Fingers* breadth distance from the Line E F; let us take above the Line C D, to the Right hand of the said Line E F, as many *Points* as we please: As for Example, G, H, D, &c. distant from each other at pleasure; and let us conceive, that from the Point A, so many *Right lines* do proceed, as to reach to the several *Points* G, H, D, &c. This granted, it is manifest that the Line A G, will cut the Point I, of the Line E F; the Line A H, the Point L, a little Higher, and the Line A D, the Point M, which surpasseth the former, or is drawn about it; and so of the rest. But because the Line C D, is *Infinite*, and that therefore an *Infinite* number of *Points* may be taken in it, it follows, that all the *Lines* that shall be drawn from the point A, to all the foresaid *points*, will denote *Infinite points* in the Line E F, and they different amongst themselves, and which will still more and more approach to the End E, yet so, as that none of all the said *Lines* will ever pass through the point E; because it is suppos'd that the Line C D, is parallel to the Line A B. Whence we conclude, that since an *Infinite* number of *Points* can be assigned in a certain determinate portion of *Matter*, that *Matter* is infinitely divisible.

V. Some one or other, it may be, will object in favour of GASSENDUS his *Hypothesis*; that if it belongs to the *Nature* of a *Body*, to be *Divisible to Infinity*, it will follow, that any *Body* will be equal to another, which is double its *Bigness*: But what greater absurdity can there be, than that 2 *Bodies* of different *Magnitudes* should be Equal? and consequently it must be false likewise, that they are both of them *Infinite* *Divisible*. The *Major* is evident, because there is an *Infinite* *Divisibility* in the *Smaller Body*, as well as in the *Greater*, which notwithstanding is twice bigger than it.

VI. This *Objection* may be answer'd, First, by saying with DES CARTES, in the First Part of his *Principles*, Article 26, That we need not trouble our selves too much, to explain or extricate these *Difficulties*, which are not proportionate to our *Intellect*, and which cannot perspicuously and distinctly be conceived by us. For it appertains only to *Infinite Mind*, to understand that which is *Infinite*, and to determine any thing concerning it. Wherefore it would be a great piece of Folly, to reject the clear Notion we have of the *Nature* of a *Body*, as false; because we are not endued with an *Infinite Understanding*, and therefore cannot comprehend that which is *Infinite*. Wherefore also DES CARTES considers all those things wherein we can perceive no Bounds of *Extension*, not as *Infinite*, but as *Indefinite*; because they can be indefinitely divided, and we can never come to the last part of them.

Or, Secondly, we may give this Answer to the foresaid *Difficulty*, that the *Divisibility* which is in the lesser *Body*, is not so much as that of the greater *Body*, which is twice as big; that is, the lesser *Body* cannot be divided into *Parts*, that are as big as those into which the greater is divisible; but yet it may be divided into as many; because *Bodies* are not said to be *Divisible* with regard to their *Continuous Quantity*, but with respect to their *Discrete Quantity*; for the *Thousandth* part of one *Body* may be divided into other 1000 parts, no less than the whole *Body*: Forasmuch as the *Divisibility* of a *Body*, or its aptitude to be divided, is not diminished by actual Partition, no more than the Faculty of *Writing* or *Painting* grows less in a man, whilst he writes upon *Paper*, or paints upon a *Board* or *Cloth*.

It will seem a Paradox to some, that there should be as great a number of *Parts* in the little *Body* of a *Mite*, as in that of a *Horse*, an *Ox*, or an *Elephant*; yet if we will be pleased to make use of a good *Microscope*, we shall find that the *Body* of a *Mite* is every whit as *Organical*, as that of the most bulky *Animal*; for we find it hath a *Bill*, with a long *Trunk*, wherewith it pierceth the *Skin*, and draws *Blood* thence for its *Aliment*. It is seen also sometimes to cast forth *Dung*, of the bigness of a *Flea*; besides which many *Asperities* may be perceived, as well on the outside, as on the inside of its *Skin*, and 2 branching *Horns* on its *Forehead*, and 6 *Feet* on each side, like to those we see in *Crabs*, long-wise extended from the sides of it, 2 whereof support the fore-part of this little *Animal*, and the other 4 the hind-part. But tho' all these outward parts of this little *Animal* be considerable for their number, yet are they but very few, if compared with many parts which lie hid in the inside of it. For it must have a *Stomack*, *Guts*, a *Heart*, a *Brain*, wherewith to perform the Functions of *Life*. It must also have *Veins*, by which its *Aliment* may be conveyed throughout all the parts of its *Body*; *Arteries*, to convey the *Vital Spirits*; and *Nerves*, to convey the *Animal*; besides, *Muscles*, *Tendons*, *Joints*, and innumerable other parts conducive to its *Nourishment*; *Sensibility* and *Capacity* of moving it self, and exerting all the other Functions of *Life*. All which *Parts*, tho' they be very small, yet are they no less divisible than those which are much greater, because they are extended, and separable into *Parts*.

Wherefore seeing that the *Demonstrations* concerning the *Divisibility* of the *Matter* are clear and evident, we may assert, that there may be *Bodies*, yea, and *Animals* too, still less and less than others, and that into *Infinity*, tho' our *Imagination* can frame no Conception of them: For why might not we say with sufficient certainty, that all *Animals* are in little in their *Seed*? Seeing that we see in that which we call the *Treadle* of an *Egg*, (which was never set upon) a *Chicken*, which for ought we know, is entirely formed; and that we see whole *Frogs* in the *Spawn* of *Frogs*. It is also very probable, that in the *Bud* of a *Mustard-seed*, and of the *Kernel* of an *Apple*, by Example, there are infinite *Trees*; because it not only contains the *Tree*, whose *Seed* it is, but also a vast number of other *Seeds*, which it may be, contain within them also other *Trees*, and other *Seeds*; which other *Seeds* do probably contain still other and more *Trees*,

IV. Forasmuch as infinite Points are assignable in a Body, it must follow, that every Body is infinitely Divisible.

Figure 4.

V. How it comes to pass, that all Bodies are not Equal, seeing that all are infinitely Divisible.

VI. A Finite Mind cannot determine any thing concerning that which is Infinite.

VII. Two Bodies of different bigness, may be divided into as many parts the one as the other, tho' not into as great parts.

VIII. There are innumerable parts in the Body of a Mite.

IX. GOD can produce Animals infinitely lesser and lesser, than others.

Trees; and other *Seeds*, as fruitful as the first were, and this to Infinity.

X. Neither may we only conclude, that *Plants* are contained in the *Buds* of their *Seeds*, but that all the *Bodies* of *Men*, and of *Animals*, that shall be born for the future, even to the end of the *World*, probably were produced from the first Beginning of the *World*: I mean, that the *Females* of the first *Animals*, have probably been created, with all those of the same *Species*, which they have already brought forth, or shall do to the end of the *World*.

CHAP. V.

Of Loose and Close Bodies.

A *Sponge*, by letting in of *Water*, or any other *Liquor*, swells and is puffed, and spreads it self into a larger Bulk.

Some suppose that a *Sponge* is rarefied by the increase of some new *Quantity*; as if nothing of Foreign Matter did enter into it, but only that some supervening *Quantity* doth separate the parts of the *Sponge*, and increaseth its bigness. But who can believe that when *Water* is rarefied, and in a manner turned into *Air*, it is only thus dilated by the increase of new *Quantity*? Who perceives not that the *Sponge* sucks in Moisture, and hides the same within it self, which afterwards upon the squeezing thereof, runs out again, whereupon the Parts come closer together. A *Sponge* therefore becomes rarefied or dilated, when the parts of it are somewhat removed from each other, and that the *Pores* of it are fill'd with supervening *Water*. And the same *Sponge* again grows close, when its Parts are brought nearer together, by the Expulsion of that Matter, which before kept them at a greater distance. So that a *Sponge* may not only be said to be a *Loose Body*, whilst it is dry and free from all Moisture; but also, and more especially, when it hath all its *Pores* fill'd and stuff'd with Foreign Bodies.

II. *Glass* becomes dilated to a greater Space by Heat, than *Metals*; and of *Metals*, *Iron* is more dilatable than *Copper*; *Copper*, more than *Silver*; *Silver*, more than *Gold*; and *Pewter* more than *Lead*.

The Reason of all which must be fetch'd from the greater Porosity of those Bodies that are more light than others; for the more *Pores* there are in any Body that is capable of being Rarefied, the more Bodies may insinuate themselves into it, and by this means it becomes rarefied or distended.

III. The Curious Searchers of Nature observe, that the Motion of Rarefaction is more intense at the beginning, and more slow and remis towards the end thereof. They produce several Experiments to prove this; and more particularly from that of Weather-Glasses, exposed to the Heat of the Sun, uniformly, and continually applied to them; or set in *Water* that is kept in the same degree of Heat.

The Reason whereof is, because Rarefaction being caused by the admission of some thin Substance into the *Pores*, the more the said *Pores* are dilated by the violent ingress of new Matter, the more the Parts of the Body rarefied become distended, and therefore do still more and more resist and oppose any further distension.

IV. *Gates* and *Doors* frequently cannot be shut or opened, in Moist weather, without some difficulty:

Whereas the contrary happens in the *Boards* whereof *Barrels* are made, which when expos'd to the *Air* in Dry weather, do open and make the *Vessels* to become leaky.

The Reason is, because *Gates* or *Doors* do swell in Wet weather, for that the *Water*, or the *Air* fill'd with watry Vapours, penetrates the *Pores* of the *Wood*, and distends the Sides of them, which being dilated, the whole Bulk of the Body must needs be distended likewise, and take up a greater Space than it did before. In like manner *Linnen-Cloth* is rarefied by the Accession of *Water*, *Water* by that of *Air*, *Air* by that of *Ether*, and *Ether* by that of a more subtil Body, if any such there be, and by this means take up more Room than they did before.

Thus also the *Strings* of a *Violin*, or other Instrument, do swell in Moist weather, as appears by their breaking, and by the difficult winding of the *Pegs*. In like manner *wooden Bowls* are apt to get *Slits*, if they be put into *Water*, and the *Water* penetrate them. Some very credible Authors relate, that *Earth* taken up from those parts that are near to the River *Nile*, do increase every day in weight, from the time when that *River* begins to swell, until it be arrived to its greatest height. Which cannot proceed from any thing else besides the *Air*; which being condensed at that time, and clogg'd with watry Particles, doth increase the weight of the *Earth*.

By the same means an *Obelisk* at *Constantinople*, which was got out of its place, was put to rights again; for the Artificer, who had undertaken the Work, having caused very strong and thick *Ropes* to be tied to the *Obelisk*, and fastned to some strong *Hold-fast*, caused the said *Ropes* to be moistned, by pouring great quantities of *Water* upon them, which causing them to swell, and consequently shortning their length, lifted up the *Obelisk* to its former situation upon its basis. For *Ropes*, consisting of long and twisted *Threads*, by admitting the Moisture into their *Pores* or *Intervals*, the more they swell in thickness, the more contracted their length is.

It is after this manner that *Mill-Stones* are separated from the *Rocks*. For they make abundance of Holes about the said *Rocks*, into which they drive *wedges* of *Wood* that have been dried in an *Oven*; which *Wedges* being placed around in the form of a *Cylinder*, according to the bigness that we would have the *Mill-Stones* to be of, when Moist weather comes these *Wedges* swell, and by their swelling separate the *Mill-Stones* from the rest of the *Rocks*; so that it is evident, that this Separation is made by the *Vapours*, which would be very difficult to perform any other way.

The *Staves* of *Barrels* take up less room in Dry weather; for seeing that their Parts are agitated by Heat, some of them fly away into the *Air*; which being gone, it is no wonder if the rest come closer together, and do not take up so much place as they did before.

Take a *Bar* of *Iron*, for Example, of 2 Foot long, and a *Stick* or piece of *Wood* of the same bigness; then put the *Iron Bar* into a strong Fire, till it be red hot, and then compare it with the piece of *Wood* which was of the same dimensions with it, when it was first put into the Fire, and you'll find the *Iron* to have been increased, not only in Breadth, but in Length also, and in both

that *Gates* and *Doors* do easily shut in dry weather, and more hardly in Moist and Rainy.

V. Why the *Strings* of an Instrument do swell by the Moistness of the *Air*.

VI. How an *Obelisk*, moved out of its station, was put to rights again.

VII. How *Mill-Stones* are separated from the *Rocks*, whereof they were a part.

VIII. Why the *Staves* of *Barrels* are contracted in hot and dry weather.

IX. A *Bar* of *Iron* put into the Fire, swells and becomes dilated.

N n n n

to

to exceed the *Piece of Wood* which was equal to it before; but as soon as it is grown cold, we shall find it restor'd to the same dimensions it had before it went into the *Fire*.

The Cause whereof is the *subtil Body*, which enters the *Pores* of the *Iron*, viz. the *particles* of *Fire*, which dilate it to a greater Extension. For the *parts* of *Fire* being in continual motion, must needs distend the *Sides* of the *Iron Bar*; which when expos'd to the *Air*, and being cooled, returns to its former Extension, because the *particles* of *Fire* leaving its *Pores*, and those of the *Air* entering into them, and not being moved with the swiftness and violence that those of the *Fire* are, they do less distend them, and consequently the *Bar* of *Iron* must take up less room than it did before.

X. Hence also it is, that with a *Red-hot Iron*, or with a piece of *Packet-bred* dipt in *Brimstone* and set on *fire*, *Glasses* are cut; because the *particles* of the *Glass* being agitated by the *heat* of the *Fire*, require a greater Space, and consequently drive their contiguous *Parts* further from them. And it is for the same Reason, that *Metals* in fusion swell, and take up more room than they did before.

XI. *Water*, by the *virtue* of the *Sun*, is lifted up into the *Air*, and becomes thereby so diffused, as to take up a greater Space than it did before; for if we may believe the account that some give us, *Water* turned into *Vapour*, fills a Space 100 times larger than that was which it took up before.

The Cause of which Diffusion is not to be attributed to the *parts* of *Water*, as some falsely do imagine; since it is impossible that the *Dimensions* of a thing should be increased, except that some other *Body* be added to it. And consequently the *Water* becomes dilated, when its *Parts* remove farther from each other, and so give way for the entering of some *Foreign Body* between them. After the same manner as when a *Heap of Dust*, by the *Wind* is lifted up, and dispersed in the *Air*: For this Expansion is not to be attributed to the *particles* of *Dust*; but to the *Air*, which fills the *Intervals* between them, and separates the *particles* of *Dust* from each other.

XII. *Condensed Bodies*, and such as after *Rarefaction* are reduced to a less Room, are commonly of a white Colour; as *Butter*, *Grease*, *Oil*, and such like.

The Reason whereof is, because in *Condensation* those *particles* are expell'd, which swell'd the *Grease* or *Oil* into a greater Room, whereupon their parts must needs come closer together, and be contracted, as it were, into small round *Pellets*, which afterwards, like so many round *Looking-Glasses*, do reflect all the *Light*, and produce a *white Colour* in the condensed *Subjects*. For there are two things especially, by means whereof *Bodies* acquire a *white Colour*: The *First* is, That they consist of little and innumerable *Surfaces*, disposed to receive and reflect the *Light* in such a manner, as that it may suffer no loss, either by *Refraction*, or by the mixture of *Shadow*. The *Second* is, That the whole *Light* which shines upon a *Body* be reflected, without having any *Beams* swallowed up in the *Pores* of it. To the effecting whereof little round *Bodies* do conduce most; as will appear, when we come to speak of *Heat*.

New Beer or *Wine*, if it be put into *Bottles*, doth swell and work with that Violence, that it frequently breaks them.

Which *Fermentation* is caused by the *Heterogeneity*, or the Diversity of the parts of *Liquor*; which cannot unite together, by reason of the variety of their *figures*, and therefore endeavour to extricate themselves from the Society of each other. And that this is the true Cause of the *Fermentation* of *Liquors*, appears from hence, that after these *Liquors* are separated from their *Heterogeneous* parts, they are no longer agitated with any such tumultuary Motions; as is evident in *Burning Spirits*, *Distill'd Water*, and the like; which may be kept a long time without suffering any Change. For the *Spirit* of *Wine* being kept closely stop'd, is not capable of any agitation of its parts; but if a little *Turpentine* be mixed with this *Spirit*, the parts presently begin to tumultuate, and endanger the breaking of *Vessels* Hermetically sealed.

If *Bread* be made out of the *Flower* of grown or sprouted *Wheat*, it will ferment and rise without the addition of any *Leaven* of *Yeast*.

The Cause whereof is, because the stiff and sharp *particles* of sprouted *Wheat* do infold themselves; and, as the *Chymists* express it, are in their greatest Exaltation: Wherefore, as soon as the *Dough* begins to grow hot in the *Oven*, the parts thereof become tumultuously agitated, and driving the resisting *Bodies* before them, do in a manner precipitate them, and by this means the *Bread* becomes spongy and light.

Let a *Weather-Glass* be fill'd with *Aqua-fortis*; but so as that when fill'd, there may be some Space left, taken up by the remaining part of the *Air*, which was before in the *Glass*, *Tube* or *Pipe*: You'll find that this part of *Air*, being dilated by a more intense *Heat*, upon the recess of the *Aqua-fortis*, retiring it self into the lower Head of the *Tube*, will fill the whole Capacity of the *Tube*; and that on the contrary, by Cold it will be contracted into so narrow a room, as that the whole *Tube* almost will seem to be filled with the *Aqua-fortis*.

Which Variety proceeds from the continual ingress of new *Matter* through the *pores* of the *Glass*, which doth so rarefie the impure *Air* contained in the *Glass*, that by the separation of its *particles* from each other, it drives the *Aqua-fortis*, being unable to resist its place; whereas upon the egress of the *subtil Matter* through the *Pores* of the *Glass*, the *particles* of the *Air* coming then closer together again, the *Aqua-fortis* returns to its former place, being drawn into it by the *Air* that enters at the lower end of the *Glass*. And if the *weather* be very Cold, that part of the *Air* which is in the upper part of the *Glass*, upon the recess of the *subtil Matter*, doth so greatly decrease, as that the whole *Glass* becomes fill'd with the *Aqua-fortis*.

A *Chest-Nut* put into the *Fire*, first swells, and soon after bursts, giving a great Report. Which doth not proceed from any foreign *Matter* that enters the *Chest-Nut*, but from the grosser parts of it, which the action of the *subtil Matter* entering into the *Pores* thereof, separates from each other, and doth so agitate, that at last they burst the *Shell* with a great noise.

XIII. What is the Cause of the Fermentation in New Beer or Ale.

XIV. Bread made of sprouting Corn ferments of itself.

XV. How the Air comes to be condensed or rarefied in a Weather-Glass.

XVI. Why a Chest-Nut cast into the Fire breaks with a great noise.

In

XVII.
How a
Marble
Pillar was
broken to
shivers.

In like manner, a vast *Marble Pillar* mentioned by *CABÆUS*, was broken all to shivers, by kindling a *Wood Fire* round about it: For the heat of the *Fire* rarefying the *Air* contained in the *Pores* of the *Marble*, makes, that it cannot be lodged in the narrow *Room* it took up before, and therefore in striving to get forth into a large *Space*, it breaks and rends the *Marble* to pieces.

XVIII.
The vast
Dilatation
of a grain
of Gun-
powder.

This *Dilatation* of *Bodies*, is the Cause sometimes that a very small *Body* becomes diffused into an incredible distension; as we see in *Smoke*, *Vapours* and *Flame*, which *Dilatation* is so great, that one *Grain* of *Gun-powder*, according to the Demonstration of *Job. Chrysof. Magnenus*, when kindled, becomes dilated into a *flaming Sphere* 3804 times greater than it was.

CHAP. VI.

Of Hard and Fluid Bodies.

I.
The
Difference
between
Hard-
ness of
Stones and
Gems does
proceed.

BOdies are distinguished by *Hardness*, as *Stone*, *Wood*, *Whet-stone*, *Pumice-stone*, *Gems* or *Precious Stones*; some whereof are broken with ease, and others not without great difficulty.

We account those *Bodies Hard*, the parts whereof are at Rest together, and are so closely united, as that they are not interrupted by any other *Matter* moving between them. And accordingly those things are accounted the most hard and firm whose parts are inflexible, and touch one another. And therefore *Precious Stones*, tho' they all agree in this, that the *File* will not touch them; yet some of them are harder than others. For some of them are polished with *white Lead*, others with *Copper*, others with *Emery*. Thus we find a great difference there is betwixt a *Diamond* and *Crystal*, tho' both of them proceed from the same *Matter*, and grow in the same places; because *Crystal* is much more soft, its *Parts* being not yet firmly grown together, but agitated with various *Motions*. Whereas the *Diamond* is much more firm and compact, by reason that its insensible parts do more immediately touch each other, and are more intimately and close entangled by mutual cohesion.

II.
A Hard
Body sus-
pended in
the water
moves
more
swiftly in
a Right
Line, than
the Water
it self doth.

When a *Hard Body* is suspended in the *Water*, if the *Water* move in a right *Line*, the said *Hard Body* will move more swiftly than the *Water* following the same *Line*.

The Reason whereof is this, because all the parts of a *hard Body* have but one and the same determination, and the several parts of the *Water*, or other *Liquor*, have every one of them theirs, which greatly retards their motion in a *Right Line*.

III.
A Hard
Body, that
swims upon
the water,
moves more
slowly than
it.

And on the contrary, a *hard Body*, that swims upon the *water* of a *River*, moves less swiftly than the *River*: For tho' all the parts of the *Hard Body* have but one only determination, and those of the *Water* have many; yet is this over and above recompensed, by the less degree of *Solidity* in the said *Body*, which is the Cause that it keeps above the *water*, and so has fewer parts of *water* to push it forwards, and more of *Air* or *subtil Matter* to resist its motion,

Bricks, made of *Clay*, become harder by being burnt or bak'd in the *Fire*; notwithstanding that after their *Burning* they have larger *Pores*, and that their parts are further distant from each other.

I suppose, that this hardness of the *Bricks* is caused by the action of the *Fire*, which not only drives out of their Cavities the parts of *water*, which I conceive to be long and slippery, like little *Eels*; but also all their other *fluid Parts*, which are not very close joyned together. Whence it comes to pass that these being taken away, the remaining parts come closer together, wherein the Nature of *Hardness* does evidently consist.

From this new entanglement of the *Parts* it comes to pass, that many *Plants* in *Brazile*, which whilst they stand in the *Ground* are very soft and flexible, being pluckt up, within a short time after become inflexible and very hard. I remember to have read somewhere of a certain kind of *Clay*, which as long as it lies at the bottom of *Rivers*, and is cover'd with *water*, is very pliant; but being taken up into the *Air* grows hard immediately, and becomes very firm and stiff.

Yea, what is more, we find sometimes that *Pieces of Wood* are turn'd to *Stone*, and that by means of a petrifying *Juice*, which being got into the pores of the *Wood*; and the watry parts of the said *Juice* being exhaled, leaving the *Earthy* and *Stony parts* in the *Pores* of the *Wood*, impart to it the *Weight*, *Hardness*, and other Affections of *Stones*. For *Wood* thus changed into *Stone*, becomes thereby almost 6 times more ponderous than it was before; and the remaining parts of *Wood* are so closely entangled and joyned with the superadded *Sandy particles*, that they can no longer be consumed by the *Fire*.

It is an unquestionable Truth, that *Bodies* which are agitated with a slow and intestine motion, do in process of time grow more hard and solid. For the *Wood* whereof *Musical Instruments* are made, require much time before they can be brought to the highest disposition and fitness for that use, even from the time of 20 to 80 years sometimes. They who make *Vessels*, and other *Utensils* out of *Guajacum*, tell us, that they must let it lye 20 years before it be fully fit for some of their uses. So much time is required, that all the *Volatile* and *watry Particles* being exhaled, the solid Parts may come more closely together, and attain that fit firmness and dryness which is necessary for them.

Water becomes congealed into *Ice*; *Breath*, *Blood*, and the like into *Jelly*, and attain all of them to some degree of Firmness. Which happens, because their *Particles*, upon the ceasing of the outward agitation hang together, and more closely embrace one another. For *Blood* and *Breath* become more firm by the Exhalation of their thinner Parts, the thicker staying behind, which being closely entangled together, are fixed by the rest. The same we experience likewise in *Oil of Anniseeds*, which in the heat of *Summer* continues fluid, and stands in need of a *Vessel* to contain it; but at the approach of *Winter*, when the *Solar Beams* do more weakly beat upon the *Earth*, it becomes a *hard Body*. So likewise *Milk*, which of its own Nature is fluid, and doth easily insinuate it self into other *Bodies*; yet becomes coagulated into

IV.
Why burnt
Bricks are
more hard
than those
that are
not.

V.
Why some
soft Bodies
grow hard.

VI.
How Wood
comes to be
turn'd to
Stone.

VII.
The way of
preparing
the Wood,
whereof
Musical
Instruments
are made.

VIII.
How Wa-
ter, Breath,
Blood, &c.
become
hard.

into Cheese, when the *stiffer, stiff and sharp Particles* that are in the *Rennet*, have penetrated the substance of the *Milk*, which by agitating the particles thereof, drive the branchy flexible parts together, and by their weight expel the smaller particles of *Whey* out of their places. *Milk* also is turned into *Butter*, when the parts of *Cream* being agitated by perpetual *Churning*, are separated from the rest, and by their *Branchy particles* entangling together, do unite into one continuous Body.

IX.
Why Water rises higher in the lesser Branch of a crooked Glass-Pipe, than in the greater.

Figure 5.

The water which is in a Crooked Pipe of Glass, riseth higher in the less branch of it, than in the greater. Because there are more Lines of Air, that act upon the Liquor that is in the great Branch, than upon that which is in the lesser: Whence it follows, that if the Liquor stop in the great Branch at A B, it will not stay in the lesser at G E, which is level with A B, but will mount upwards towards D, where I suppose that the weight of the water, which is above the Level G E, doth compensate or make good the inequality of the pressures of the Lines of Air, which act upon both the Branches. Wherefore seeing that this Inequality is by so much the greater, by how much the Mouth of the little Branch is less, or narrower, because the lesser the Hole is, the less power the Air hath to exert its activity upon it; therefore the less the Hole is, the higher will the water mount above the Level. This is no more than Experience confirms to us: For when the Pipe is about the thickness of a Quill, the water mounts only the height of 2 or 3 Lines; whereas if it be so small that scarcely a Horse-hair can enter it, the water will mount the height of 10 or 12 Inches above the Level.

X.
Salt is dissolved in Water, by the motion of it.

Salt melts in Water, notwithstanding that it is more ponderous than Water, and sinks to the bottom.

Which happens, because the parts of Water being in continual motion, do insinuate themselves into the particles of Salt, and having dissolved their connexion, do separate them from one another and spoil their Continuity. For this melting or dissolution of Salt, cannot be brought about without motion: For tho' the Water, which is contain'd within the Hollow of a Glass-Vessel, seems not to move; yet considering the fluidity of Water, we must conclude, that some of its insensible Parts are continually moving upwards and downwards, as well as from side to side of the Vessel: By which agitation the parts of the Salt become dissolved, and are separated from each other.

XI.
How Metals are dissolved in the Stygian Waters.

Thus also Metals are dissolved in Acid Spirits, and that within a short time. And for the same Reason it is, that when Oil of Tartar per deliquium is insill'd into these Stygian waters, it produceth a great ebullition or effervescence. And it is for no other Cause, that Bread or any other spongy Body, if it be but slightly dipt in water, is spoiled thereby, than this, that the Particles of the water being in continual agitation, do enter the Pores of those Bodies, and by this means make a separation of their parts from each other.

XII.
How fluid Bodies come to be hard.

Liquid Bodies do frequently become hard and firm: Thus the white of an Egg, by boiling, becomes hard.

This Hardness proceeds from the Contexture and Figure of their parts, whereby they are so

adapted together, as to cling to one another as it were with Hooks and Holdfasts, so as that afterwards they can no more continue their motion. Thus the most highly Rectified Spirit of Wine, and the Rectified Spirit of Urine, being poured together, joyn and coagulate in the form of Snow. Because the dissolved Sulphur, which constitutes the Spirit of Vine, having insinuated its little Branches into the Pores of the sharp Volatile Salt of the Spirit of Urine, doth so link the parts together, and reduceth the Pores of that Compound to such a narrow compass, that the Matter of the First and Second Element, which passeth through them, is not capable of imparting to those Liquors their ordinary Fluidity; and by this means are reduced to the consistence of a kind of Hard Body. The same effect is also produced by mixing Spirit of Vine with the beaten White of an Egg. And it is for the same Reason that Spirit of Turpentine, after reiterated Distillations, is turned into a hard Body.

Common-water, that hath run through Earth that is impregnated with Nitre or Saltpeter, and set upon the Fire to boyl, continues as Liquid as ever; but being removed from the Fire and grown cold, it sets a Mass of Salt, and becomes Crystalliz'd.

XIII.
How common Water, impregnated with Saltpeter, grows hard.

The Reason whereof is, because the Water being grown cold, many of those particles of Salt, which were agitated by the heat of the Fire, cease their Motion, and coming closer together, embrace one another; and by this means are Crystallized, and return to their former figure: Alom yielding 8 Corner'd Crystals; Salt Armoniack 6 Corner'd; Sea Salt, Cubical or Square; Salt Nitre Pyramidal; and other Salts, Crystals of other Figures.

When any Sour Liquor is poured into warm Milk, immediately the Curds are by this means separated from the Whey; as appears in that Drink so familiar amongst us here in England, called Sillibub.

XIV.
How a Sillibub is made.

This Separation happens, because Milk is not altogether fluid, but is of a somewhat thickish consistence, whose Pores are encompass'd with grosser parts, which are the Curds whereof Cheese is made: And therefore when any sharp or subtil Liquor enters the same, such as Vinegar, Cider, or the like, it drives away the grosser Particles, that fill the Pores, which thereupon joynning together, become separated from the Wheyish part. The same also happens when Milk is kept so long that it turns sour; for then, without the assistance of any Rennet or foreign Liquor, it is precipitated and falls down to the bottom, especially if it be set near the Fire; because when Milk grows stale, its thinner parts become fluid, and being sowed with the warmth, serve instead of sour Liquor or Rennet, to run the Milk together.

Oil cannot be washed out of Cloth with water, but Lie must be us'd, or Soap, which is not so fluid as water, but by its consistence appears to be endued with a far less degree of Motion.

The Cause whereof is, because the Parts of Water, as to their Figure, differ from those of Oil, and therefore cannot penetrate or divide each others Parts: For the particles of Oil are Branchy, whereas those of Water are slippery, and much in the shape of Eels: For which Reason also they enter

XV.
Oil cannot be taken out of a Cloth by Water, but well with Soap.

enter the pores of a Cloth stained with Oil, and leave the particles of Oil untouched. For Water hath not the force to enter into Oil, or to penetrate into the inmost parts of it; and consequently cannot carry off any parts of the Oil with it. Whereas Lie, because of the Salt that is mixed with it, doth readily perform it; for the parts of Salt being stiff and inflexible, and therefore like so many Darts piercing into the parts of Bodies, doth easily loosen the particles of Oil, and being mixt with water, easily carries off the Oil with it. And hence it is that Soap is of so great use, for the taking of Spots or Stains out of Cloaths, because it consists of Salt, Oil and Water. For the little particles of Oil, because of their familiarity, are easily united, which the water extracts by being joyned with the particles of Salt.

XVI.
What is
the Cause
of the
Rising or
Falling of
water in a
Glass.

When any Liquor is put into a clean Glass Vessel, having an even Brim, and fill'd up to the top, the Surface of it appears plain and even; but not so when the Vessel is only fill'd in part, because then the surface of the Liquor seems to be concave or hollow in the midst.

The Cause hereof is, because the Air in the former case doth with an Equal force press upon the Liquor; nor can any Reason be assign'd, why it should press one part of it more than another. Whereas in the latter case, the Air being whirl'd round about the Glass with water, whilst from abroad it enters into the hollow of the Glass, it is not so much dispos'd to turn its Force towards the Sides of the Glass, as to continue its motion towards the midst of the water; and consequently presseth the Liquor more in the midst, than towards the Sides of it, which therefore are somewhat higher than the midst, which by the greater pressure of the water links somewhat lower.

XVII.
Why
water
comes to
have a
round
Figure.

But if you pour into a Pipe, or other Vessel, somewhat more water than it is well able to hold; because that part which is ready to spill over the brims of the Vessel, is more expos'd to the Air, than that which is elsewhere; therefore the Air drives it by its pressure more towards the midst, where is the fittest place for it to swell or rise higher. Thus we see that the water in this Pipe or Vessel swells above its brim, and that the swelling or Rounding thereof comes nearer to a perfect Round in a small or narrow Pipe; because where the Vessel is very large, the Force of the Air is not strong enough, to overcome the weight of such a great quantity of water.

XVIII.
Why a
Lead
Bullet is
more easily
beat flat
upon a
Cushion,
than on an
Anvil.

A Leaden Bullet being laid upon a Cushion, or a pendulous Anvil, is more easily beaten flat, than upon an Anvil that stands fast and immovable.

The Reason is, because it is not sufficient to the beating of a Bullet flat, to strike it with a great force; but it is over and above requisite that this Force continue for some time, that the parts of the Bullet may have leisure to alter their situation: But when such a Bullet is laid upon an immovable Anvil, the Hammer leaps back almost the very same moment it strikes the Bullet, and so hath not time enough to flat it, as it hath when it can continue longer upon it, as when it is laid upon an Anvil or other Body that gives way to the stroke of the Hammer, and doth not by its Solidity immediately beat it back. Thus the Shin-bones of a Sheep are more easily broke upon the

hand, than upon an Anvil; because the Hand, by giving way to the force of the stroke, assists the breaking of it.

When Air is blown into a Leathern Ball or Bladder, it makes it to become hard, tho' the Air of it self hath nothing of Hardness in it.

The Reason is, because the parts of Air that are pent up in a Leather Ball, or Bladder, being unable to penetrate the Parts thereof, are by this means so much compressed, that thereby they are forced to change their figures, and bend like so many little Bows, which endeavour to return to their former and natural posture; and by this means so distend the Ball, and make it feel hard to the Touch.

Fluid Bodies, that communicate with other fluid Bodies, are Heavy, proportionable to their Height, and not according to their Breadth. As for Instance, Let us suppose a Vessel full of water ABCD; having 2 Openings or Mouths of unequal bigness E and F, to which are solder'd 2 Pipes likewise unequal, such as G and H. This supposed, if you pour the same Liquor into the said 2 Pipes to the same height, both the Liquors will be in an Equal poise.

The Reason is, because their Height being the same, they are in proportion to their Thickness; that is to say, if the Hole E be double to that of F, there is also twice as much Liquor in the Pipe GE, as there is in that of HF; whence it follows, that the Liquor of the great Pipe cannot sink 1 Thumb breadth lower, but it must make that in the lesser Pipe to rise 2; nor can that of the lesser sink lower by 2 Thumb breadths, but it must make that in the greater Pipe to rise 4 Thumb breadths, which makes an equal quantity of motion on either side, and consequently the water continues in equal poise in both the Pipes.

A Hard Body, for Example a Beam of Wood, being in the midst of a Pond, continues unmoved; and except by outward force it be put into motion, it always observes the same distance from the Bodies that surround it.

Which proceeds from hence, for that the Parts of the Fluid Body, which every way encompasses the Wood, are tost with various motions, some upwards others downwards, some to the Right, and other to the Left; so that the Wood receiving all their contrary motions, rests in an equal poise between them all; since there is no cause that might incline it one way more than another. But if the whole Fluid Body tend one way, the Wood will be forc'd to comply with its motion, and be carried along with it; because in this case the Contrariety of the motions in the water is removed, by the waters running one way only.

The Plaster wherewith the Walls of Houses and Roofs are cover'd, grows hard by its being mixed with water, and by this means acquires a firmness, which it never had before.

Some do imagine the Cause hereof to be from the sudden evaporation of the parts of Water, which by being sublim'd into the Air, leave the rest of the Body hard: But Experience teacheth us the contrary; for if Plaster of Paris be weigh'd whilst it is almost Liquid, and be afterwards weigh'd again, after that it is grown hard, it will be found to have lost nothing of its weight.

XIX.
How a
Leathern
Ball or
Bladder is
made hard,
by the Air
that is
blown into
it.

XX.
Liquid
Bodies are
ponderous,
proportion-
ably to
their
height.

Figure 6.

XXI.
Why a
Beam of
wood lies
unmoved in
the water,
tho' the
parts of
the water
are in
continual
motion.

XXII.
Water
sometimes
conduces to
the
Hardness
of Bodies.

For my part, I suppose this Hardness is produc'd, because in the *Plaster* there are many *Pores*, which the *Fire* hath formed in it, and are such as that the thicker *Particles* of *Air* cannot enter into them, because they have not strength enough to remove those *Obstacles* which they meet with in the *Plaster*; which yet the *particles* of *Water* can do. Whence it comes to pass, that the *water* having been variously agitated with the *Plaster*, by flowing about the *Grains* or *Clots* of it, variously opens the *Pores* of it, and divides it into much lesser parts than it was before: And forasmuch as these *Particles*, by being reduced into most fine powder, have acquir'd more Surface than they had before, when they were yet in *Clots*, being now joyned together by a more immediate contact, they do constitute a *hard Body*.

XXIII.
Why Cement becomes as hard as Marble.

And it is for the same Reason, that a *Cement* made of *Flower*, the *White* of an *Egg* and *calcin'd Stones*, turns as hard as *Marble*, wherewith the *Sides* of that wonderful *Fish-Pond* at *Cuma* is walled. So likewise it is a thing well known, that the *Powder* of *Flints* and *Loadstone* being mixed with the *white* of an *Egg* and *Sanguis Draconis*, doth within a few days become an exceeding hard *Mafs*.

XXIV.
Why Aqueous Liquors are easily resolved into Vapours; but fat and Oily Liquors not so.

Aqueous and *volatile Spirituous Liquors* are easily resolved into *Vapours*; whereas *fat* and *oily* are not without much difficulty exhaled.

The Reason is, because the parts of the former, are endued with very simple *Figures*; whereas those of *fat Liquors* are of more intricate *Figures*, like *Branches* of *Trees*, by which means they hang and cling close together, and therefore cannot without difficulty be separated from each other.

CHAP. VII.

Of Rough and Smooth Bodies.

I.
Many Bodies that appear smooth and polish'd to sight, are rough notwithstanding.

Marble, Steel, Wood, &c. appear smooth; but yet are found to be rough by the help of a *Microscope*.

The Reason is, because *Bodies* are commonly polish'd with the help of very hard *Powders*, the *grains* whereof cannot but leave *Cavities*, and consequently *Unevenness* in the *Surfaces* of the *Bodies* so polish'd. *Pumice-stone* is also made use of to this purpose; because by its *Roughness*, it rubs and wears off the *Prominences* of the parts. And with these *hard Powders* always some *Water* or *Oil* is mixt, which prepares the *matter*, and conveys the *powder* into all the *Cavities* of the *Stone*, or other *Subject* that is to be polish'd. But however, after all the pains that is taken, *Art* can never so polish *Bodies*, but that some insensible *Prominences* and *Subsidences* will still remain.

II.
Glass and Crystal are not absolutely smooth Bodies.

Thus *Glass*, *Crystal*, and the like, tho' they seem to be the smoothest of all other *Bodies*: Yet may truly be said to be *Rough*; for tho' *Glass* be made by *fusion* of the smallest *particles* of *Ashes*, yet forasmuch as they are irregular and angulous, they cannot be so bent by the force of *Fire*, as to cling closely together, and by this cohesion to lose all their own *Figures*: For tho' the protuberant *Corners* of *Glass* may be worn off somewhat, yet can they never be so adapted, but that some of them will get out beyond their Fel-

lows. And tho' this *Unevenness* of the parts of *Glass* be not visible to us, yet must we not therefore deny it, because we know that our *Senses* are not sufficient to discover all the *Affections* of *Bodies*, and often mistake in those things, which *Reason* proves to be most clear and evident. A *Line* drawn upon a *Paper* doth appear *strait*; which beheld through a *Microscope* is found to be crooked, and to have many *Inequalities*.

In like manner, there are many other *Bodies* which to our *Sight* and *Touch* seem to be absolutely smooth, whose *Surfaces* notwithstanding are made up of most thin prominent *Filaments*, with their *Intervals*, according to the demonstration *Microscopes* afford us of them. Thus Mr. *H O O K* hath demonstrated the strange asperity and roughness of the *Point* of a *Needle*, and the smoothest *Edge* of a *Razor*, *Micrograph. Obs. I & 2*. Yea, all *Metals*, how polish'd soever, and *Lead* also, notwithstanding its great compactness, represents great *Asperities* to the *Eye* that consults them, assisted with a *Microscope*.

Bodies that have a *Rough surface*, commonly cast a *whitish* Colour; but being moistned with *water*, they draw to a *blackish* Colour.

The Reason is, because *Rough Bodies* consist of many *Faces*, many whereof are so turned towards us, that howsoever the *Rays* of *Light* fall upon them, they reflect copious *Beams* to our *Eye*, and consequently produce *Whiteness*. But when the *Surface* of a *Rough Body* is wetted with *water*, these *Unevennesses* or *Faces* are taken away, which before did reflect the *Rays* of *Light*, and consequently must make it appear of a *darker* Colour.

Polisht Bodies reflect the *Rays* they receive towards one part, which therefore becomes more bright and shining than the rest, which rather appear obscure and darkish.

Which proceeds from hence, because the *Expansion* or *spreading* of the *Rays* reflected from *Bodies*, is produced from the various *Inclination* and *Eminence* of their *Parts*. And therefore *Artificers* do cut and grind *Diamonds* into several *Angles* and *Surfaces*, that from them the *Light* might be variously reflected and diffused. Thus *Silver Vessels*, when boil'd in a *white-wash*, become white as *Snow*; but if after this, any part of them be polish'd, they lose their *whiteness*, and become *brown* and *darkish*, and like *Looking-Glasses*, reflect their *Rays* towards one place only; because the eminent *particles*, which were the cause of their *Roughness*, are taken away by *polishing*, and therefore it cannot be otherwise, but that that *Light* which falls upon them, must be directed to one certain place. As we see in an *Iron Breast-piece*, which being polish'd, at sometimes, appears very bright and resplendent, and at others *dusk* and *dark*.

Two Pieces of *Marble* exactly polish'd, do so closely cling together, that the lowermost of them by its own weight cannot fall down from the uppermost; no nor in case a much heavier weight be applied to it, to draw it down, nor can it be separated from it, but by very great force.

The Cause hereof is to be fetch'd from the weight or spring of the *Air*, which presseth the two pieces of *Marble* together. Wherefore seeing that the parts of all *Bodies* that are here with us, are

III.
The most exactly polish'd Bodies are Rough.

IV.
Rough Bodies generally cast something of a white Colour.

V.
Smooth Bodies have one part more shining.

VI.
Why two polish'd Marbles are not without difficulty separable from each other.

are prest against each other, by the superincumbent Air, or the ponderous Exhalations and Effluvia of Bodies, it is obvious to conceive how much the simple Contact of the small particles of any Body, according to their whole Surfaces, doth conduce to the causing and preserving of the firmness of Bodies; not precisely, because the parts do touch one another; but because, together with that Contact, there always is an outward Cause, viz. the weight of the pressing Air, which is able to preserve that Contact, till by a greater Force supervening they be separated from each other.

VII. *Whence the Mossiness and Mouldiness of Bodies doth arise.* Some Bodies are very subject to grow mossy and mouldy, as Houses that are cover'd with Tiles or Thatch, the outside of Walls, and Ground that hath not been tilled of a long time.

This Mossiness and Mouldiness is caused, when the lesser particles in their Exhalation out of Bodies, are seized by the Groffer and Bigger, and are hindered from flying away and leaving the Body; for by this means, being mutually entangled, they stick fast to the Surface of it, and turn into a kind of Down. Thus we find, that old Trees breed more Moss than others, because their Juice is not so well digested as to spend it self all in Branches and Twigs; but because of its weakness is stopt in its way, and covers the Bark of the Tree with a kind of mossy Down.

VIII. *Why a Pumice-stone cannot be polished.* A Pumice-stone, and several other sorts of Stone, are not capable of being polished.

The Reason is, because the Pumice-stone is a porous Body, and its pores are so wide, that the parts of it can never be brought by any Art to the smoothness of polished Bodies; but after all that can be done towards the polishing thereof will appear rough to the Touch.

IX. *No absolute smoothness can be found in Bodies.* From what hath been said, we find reason to conclude, that there is no Body which can be said to be absolutely smooth. For, First, the most smooth and polished Bodies have Pores, and consequently to many Cavities, which are inconsistent with absolute Smoothness. Secondly, The Artifice that is used for the polishing of Bodies being performed by Whetstones, or very hard Powders, cannot but leave some Unevenness upon them, as we find by the Microscope in the Surface of the most polished Steel, or the smoothest Edge of a Razor. And so likewise it cannot be otherwise, but that hard Powders, used by Glass-Grinders, must leave streaks and furrows, tho' imperceptible, to the unassisted Eye. So that whatsoever is commonly spoken of the smoothness or evenness of Bodies, must only be understood with respect to the Senses, but not absolutely.

X. *Polished Bodies do more strongly act and resist, than Rough Bodies.* Polished Bodies exceed Rough Bodies in the force of Acting and Resisting, as may be seen in Knives and Swords, which when Rusty, cannot cut or penetrate Bodies so well, as when they are whetted and smooth.

The Reason is, because Rough Bodies have their Surfaces very uneven, some of their parts jetting out, and others subsiding: Which Unevenness of the Surface is a great hindrance to motion, and is the cause why the Bodies that are struck against them, do more faintly rebound from them. Thus we find, that a Ball will rebound much further from a smooth, than from a rough Body, which those that play at Ball are very well aware of;

and accordingly, neither can it be any wonder that a smooth and sharp Knife doth cut better and more readily, than another that is all cover'd with Rust.

C H A P. VIII.

Of Transparent and Opaque or Dark Bodies.

SOME Bodies are almost wholly pervious to the Rays of Light, and reflect but few of them: Others resist the free passing of the Beams, and in some parts only suffer the Beams to pierce them.

I. *Why some Bodies are more transparent than others.*

This Transparency of Bodies consists in the direct or strait position and ranging of their Pores, without any respect had to the Neighbouring Bodies, whether they be continuous or contiguous, because they make no change in the case. For supposing this strait position of the Pores, a luminous Object, will as well affect our Eyes, as a Colour'd will, and impress its Image on our Brain. But when this situation of the Pores comes to be changed, then the Beams of the luminous Body are either not transmitted at all, or do not clearly exhibit the Image thereof, but confusedly and disformedly; because they pass through the Body, not in Rank and File, but in a tumultuary huddling manner crowd through it.

Glass is more transparent than Paper, and admits a more free passage to the Light.

II. *Why Glass is more transparent than Paper.*

The Reason is, because tho' in Paper, as well as Glass, there be pores which admit the Light coming upon them, yet are they not ranged after the same manner. For in Paper the pores are irregular and confus'd, by reason of the various entanglement of the Threads whereof it doth consist; which obstructs the Action of the Light, for those pores which are open on the utmost Surface, as they go deeper, are obstructed by crossing Filaments. But in Glass there is such an Arrangement of parts, that the pores are all continued in a strait Line, so that the Light most readily glides through them, according to that of the Epicurean Poet:

—nor can the Beams of Light
Through any Body freely reach our Sight,
Except the Pores in straightest Lines be rang'd,
As they're in Glass—

For Glass, when it was first made, and was yet in fusion, the particles of the Fire piercing it every way, formed innumerable pores in it, through which the Globuli of the second Element finding a free passage, are able to transmit the Action of Light, which consists in their pression, every way in strait Lines.

There are several ways whereby Transparency may be produced: First, By melting: Thus we find that Snow and Butter by being melted, become transparent. Secondly, By the intrusion of some proper Body, by means whereof a due position of the Pores is introduc'd: Thus Paper anointed with Oil transmits the Light, and is made Diaphanous. Thirdly, By Resolution: Thus we see that the Waters or Spirits distill'd from Opaque Bodies, as of Roses, &c. are transparent. Fourthly, By Concretion or Coagulation, by which means the Diamond and

III. *Transparency may be acquired several ways.*

and *Crystal* attain their perspicuity. *Fifthly*, By polishing and wiping off the *Dust*: Thus *Glass* by being polished, and after it is polished by being dusted, becomes transparent, and affords a free and undisturbed passage to the beams of *Light*.

IV.
How *Glass* is made more dusk and obscure, by the addition of new parts.

The perspicuity of *Glass* is diminished by the same degrees, as it increaseth in Thickness and Bulk.

The Cause whereof cannot be assigned to ought else, but the *Inequality of the Pores*: For seeing that *Glass* is not altogether transparent; but consists of many thick parts, which reflect the Beams of *Light*; it cannot be otherwise, but that many of its pores must be obstructed by the addition of new Matter, and consequently the Action of *Light* hindered. As we see that a man may, through the joyning of his *Fingers*, perceive Objects; but if he lay the *Fingers* of his other *Hand* athwart them, they will stop those little slits or gaps through which he could see Objects before. In the same manner, tho' a thin *Glass* does readily transmit the beams which fall upon it; yet will it stop and hinder the *Sight*, if it increase considerably in thickness, because its pores by this means are interrupted and are made unequal. And it is evident, that the *Inequality of the Disposition of the parts* alone is sufficient to render that *Opake*, which before was *Diaphanous*. Thus we find that the *Grains of Indian Sand*, beheld through a *Microscope*, are not only pellucid, but sparkle like *Diamonds*; but when by being heaped together they can no longer give free passage to the *Light*, they shew *Opake* or *Dusky*.

V.
How *Vintners* fine their *VVines*.

It is a thing common with *Vintners*, to fine their *Wines*; that is, to make them clear and pellucid, by means of *water-Glue*, ordinarily called *Izinglass*, and the *whites of Eggs*; making use also sometimes of *Alabaſter*, and calcin'd *Flints*, for the same end.

For the first of these, consisting of *Viscous* and *Tenacious* parts, do easily entangle the *ſaculent* parts of the *Wine*, and sink with them to the bottom: And the other, have a *Precipitating* force or virtue; and therefore entering the *Pores* of the *Wine*, do precipitate the more dreggy parts of it. In like manner they correct *Ropy-VVines*, by adding to them *burnt Alom*, *Quicklime*, *Plaiſter of Paris*, *Salt*, and the like; for all these produce a new *Fermentation* in the *Liquor*, and so cause a separation of the grosser parts, which are sent down to the bottom. And by this means the *VVine* recovers its former consistence and pellucidity.

VI.
VVater is more opake than a *Mist*.

Tho' *VVater* seem transparent to the *Eye*, yet is it less pervious to the *Light*, than a *Mist*: For if a man, from the top of an *high House* or *Tower*, look down towards the *Earth*, he will be able to perceive it through a *Mist*; whereas he finds that his *Eye-sight* cannot pierce to see the bottom of a *River*, where the distance is as great from the Surface of the *River* to the bottom, as from the said *high Tower* to the ground. And therefore *Divers* witness, that after they are got 12 or 15 *Cubits* under *water*, they can neither perceive the *Sun*, nor any thing else. Which is an evident Argument, that the *VVater* is an *Opake Body*, and much more dusky than a *Mist*.

The Reason hereof in *VVater* seems to be the

Thickness of its parts; which being irregular, and of unequal Figures, easily hinder the Globuli of the second Element from passing through them in strait Lines. For we must conceive a Body to become *Opake*, when the said Globuli cannot pass through it, but by oblique ways, and when their course is stoppt by thwarting particles. Now a *Mist* is more transparent than the *VVater*, because it consists of thinner parts, and such as are more ready to comply with the motions of the subtil Matter, and easily make way for them: For tho' the parts of the *Mist*, as well as the *VVater*, be irregular; yet they differ in the Magnitude, because the particles of a *Mist* are more fine and subtil, and not so closely entangled, as those of the *water*. Whence it is that the Globuli of the second Element move them with more freedom, and more easily thrust them out of their places; which is the true Reason why a *Mist* doth less oppose the transmission of *Light*, than *VVater* doth.

VVine, *Milk* and *Blood*, with many other *Liquors*, are *Opake*.

VII.
Why many *Liquors* are opake.

And the Reason is, because they are not pure and simple *Liquors*, but are throng'd with many *Heterogeneous Bodies*. It is a thing very notorious, that *VVine*, when it is distill'd, leaves many Bodies behind, which will not rise in *Vapours*. And this is the reason of the great clearness of *Spirit of VVine*; for being by *Distillation* freed from all its *Heterogeneous parts*, which were an hindrance to the free passage of the Rays of *Light*, it becomes wholly transparent, and that in the highest degree. *Milk* also is *Opake* for the same reason, for we find that when the *Curds* are separated from it, the *VVhey* is in a great measure *Diaphanous*. And the same is to be said of *Blood*, and other such like *Liquors*, which never appear thick or troubled, but when some strange Bodies are mixed with them, which obstruct or come athwart their Pores.

Beer, *Ale*, and other *Liquors*, after fermentation become clear, and are not thicker or more troubled at the bottom, than at the top.

VIII.
How *Liquors* are made clear and transparent.

And this, because the Matter of the second Element, moving in the pores of Liquid Bodies, do continually drive the particles of the third Element out of their places, till they have so disposed of them amongst others, that they do no more resist their motion, than those others do; or if they cannot so dispose them, till they have wholly separated them from the rest. Thus we see that *New Wine* doth not only cast some of its dregs upwards towards the Surface, and precipitate others of them downwards (which might be attributed to the Lightness or Heaviness of the particles so separated) but also to the Sides of the Vessel. And the same estimate is to be made concerning pure *Liquors*.

So for the most part *Urine* is clear and transparent, whilst the *Heat* helps to keep the pores more lax and open, and consequently leaves a more free way for the *Light* to pass: But when either the pores are contracted by *Cold*, or stoppt with various little Bodies, they are the cause of the Opacity of the *Urine*. For indeed, there are but very few *Liquors* which are without any *Opake particles*.

IX.
Why *Urine* is sometimes clear and transparent.

And

X.
Why our
hands are
commonly
more dirty
in Winter,
than in
Summer.

And for the same Reason it is, that our *Hands*, during the *Winter*, are more dirty; because the *particles* that should exhale through the *Skin*, continue sticking under it, and that because of the greater constriction of the *pores*, so that the exhaling Matter is hindered from flying away into the *Air*: Whereas in *Summer* time, when all the *pores* are open, all these gross Exhalations are carried up into the *Air*, and consequently leave the *Hands* clean. Wherefore in *Cold* weather it is good to wash the *Hands* with warm water, to help to open the *pores*.

XI.
Why Cry-
stal loseth
its perspi-
cuity, when
cast into
the Fire.

Crysal, if it be cast into the *Fire*, or for a Minute or two be cover'd with *hot Ashes*, it loseth its *Diaphaneity*, and seems to degenerate into a quite different *Body*; neither can it afterwards, by any known Art, be reduced to its former perspicuity.

Which can only be attributed to the *particles* of *Fire*, which violently rushing into the *pores*, do break their order, and consequently produce a new ranging of the parts. Now this confused disposition of the Parts, destroys perspicuity; as shall be shewed more at large, when I come to treat of *Qualities*.

XII.
How it
comes to
pass that
two clear
Liquors
mixt to-
gether con-
stitute a black
Body.

It has been found by Experience, that from the mixture of 2 clear Liquors, a black *Body* doth arise: For the Infusion of *Galls*, which is clear, being mixed with a solution of *Vitriol*, makes *Ink*.

The Reason whereof is, because the *particles* of both these *Liquors* being mixed together, do so intimately close and unite, that by the closeness of their ranging, they hinder the passage of the *Beams* of *Light*. For in either of these *Liquors* there are certain little *Bodies*, which when joyned together, neither transmit the *beams* of *Light*, nor suffer them to reflect from the *Body*, but do, as it were, wholly swallow them and keep them Prisoners. But if you add to the *Ink*, *Aqua fortis* or *Spirit of Vitriol*, it will become clear again, like *Spring-water*; because the *particles* of this new infused *Liquor*, do separate the contiguous *Bodies*, and open the shut up *pores*. But if *Oil of Tartar per Deliquium* be added to the changed *Ink*, it will be restored to its former *Blackness*; because *Oil of Tartar* joyns it self with the *Spirit of Vitriol*, and the *particles* of the *Galls* and *Vitriol* do again embrace each other. It is also from the same Cause that *Spirit of Wine*, in which *Annis-seed* hath been boil'd, when mix'd with *water*, yield a *white Colour*; and *Oil of Tartar*, when mixed with *water*, becomes troubled and opaque; that is, because the order and disposition of their Parts is troubled, and the passage of the *Ethereal matter* hindered, by little super-added *Bodies* that obstruct the *pores*.

XIII.
The Reason
of the
variety of
Colours
arising
from the
mixture
of various
Liquors.

Hence it is that when we write with the clear and transparent Infusion of *Vitriol*, the Letters do not appear at all, except that the Paper hath been done over with the Infusion of *Galls*; but a Pen dipt in the *Spirit of Vitriol* will efface these *Characters*, which will appear again when drawn over with a Pen dipt in the *Oil* or *Liquor of Tartar*. And the cause is much the same in other Colours produced from the mingling of 2 clear *Liquors*. Thus the *Salt of Tartar* dissolved *per Deliquium*, being poured into a solution of *Calcin'd Tin*, gives a *blew Colour*; the same added to a solution of *Lead* in distill'd *Vinegar*, yields a *white Colour*; and being dropt into an Infusion of *Mercury Sublimate*, affords a *yellow*;

Antimony Calcin'd with *Nitre*, and boil'd in common *water*, leaves the *water* that is strain'd from it clear and transparent. All which diversity proceeds from the various disposition of the *particles* whereof these *Bodies* are compounded, which causes the *Rays of Light* to receive a different Reflection from their several *Surfaces*.

C H A P. IX.

Of Bodies that are Bended and Pressed together.

A *Bow*, made of *Steel* or *Wood*, being bent, returns to its former state.

The Reason whereof I suppose to be, because the *pores* of the *Bow*, by the bending of it, becomes so narrowed, that the *subtil Matter* cannot freely pass through them; and therefore pushing against them with greater force than ordinary, strives to make its way through them, as formerly. Now this may be done several ways; for if we conceive the *pores* of the *Bow*, before it was bent, to have been of an even wideness from beginning to end, but that by being bent the ends of the said *pores* are narrowed, it is evident that the *subtil Matter*, which passeth freely through that part of the *pores* which is widest, when it comes to the narrow *Extremities*, will endeavour to disentangle it self, and pass further. But if the *pores* of the unbent *Bow* be supposed of a round figure, and that by the bending of it they are reduced to an *Elliptical figure*, the *subtil Matter* will exert its endeavour, to bring them to their former round figure, and consequently will restore the bent *Bow* to its former state. For tho' the *Globuli* of the second Element, with respect to their bulk, are but of little force to shake the sides of the *pores*; yet because they continually croud in great numbers into the *Cavities* of the *Bow*, striving to make their way through them, all their Forces being joyn'd, and conspiring to this end, are sufficient to effect it.

And it is for the same Cause that *Iron-wire*, made to wind spirally in Rings, like a *Serpent*, and shut up in a *Box*, as soon as the *Box* is opened, it leaps out of the *Box*, like a *Serpent*, shooting it self at some body. Thus also the bended *Boughs* of *Trees*, as soon as they are let go, fly back with great force and violence, so as to carry vast weights up with them: Because by this bending the parts of the *Boughs* are compressed together, which upon the impulse of the *subtil Matter*, striving to enter the compressed *pores*, are driven to their former state and posture.

On the contrary, a soft *Plant*, such as is the *Elder*, flies back but a little; a *Hazel-tree*, which is harder, more; because the fore said *subtil matter* passeth with more ease through the open *pores* of the former, and with greater difficulty through the straiter *pores* of the latter. Thus *Glass* that is bent, returns with greater force; because the parts of it are not joyned by the mutual entangling of their *Branchy particles*, as those of *Plants* are, but only by their *Surfaces*: And therefore when the figure of the *pores* of *Glass* is changed, the *subtil matter* exerts a more forceable impulse to restore the same. A Proof whereof we have in a *Plate of Iron*, which by being much hammer'd, acquires this

I.
What is
the Reason
that a bent
Bow, as soon
as slackned,
returns to
its former
state.

II.
Why
Vines and
the Boughs
of Trees,
that are
bent, return
to their
Natural
posture of
themselves.

III.
Some Bo-
dies upon
their being
bent, re-
bound or
fly back
more
strongly,
others
weakly.

P p p p p

this

this force or spring to fly back. Thus likewise the *Air* it self, by being comprest and pent in *Pneumatick* or *Hydraulick Pipes* or *Instruments*, when it is left to its liberty again, it dischargeth the *ullets* or *water* with as much force, as before it had been pent in and comprest; and all this from the attempt of the *subtil Matter*, to restore the changed pores to this former state and figure.

IV.
Why all
the wa-
vings this
way and
that way,
take up
the same
space of
Time.

A *Cord* or *String* fastned at both ends to fixed *Bodies*, being forced from its situation, runs out and returns, or waves this way and that way in the same measure of time, tho' it doth not always measure the same space of place.

The Reason is, because, as in a *Body* that hangs down, the several *motions* of the several *Excursions* are equal to the time of their Returns, By the Altitude of that *Circle*, the *Arcs* whereof are described by the hanging *Body*: So in like manner in a stretched *Body*, all the Moments of time wherein the *middle part* of the *String* waves out one way, are equal to that one time, wherein the other Extream, in case it were cut loose, would strait pass through the whole length, and come to the place of the other, to which the unchanged force would still draw it back.

V.
Why the
Excursions
of a string,
are not
equal to
the degree
of its being
stretched.

If you demand, why a *String* that is as long again, if it be equally stretched, doth make its *Excursions* as slow again as another: But if the *String* be stretched as much again, it doth not make its *Excursions* as swift again; but to the end it may do so, the force of the stretching must be 4 times as great.

I Answer, that forasmuch as all the *Excursions* of every *String*, be they of what length they will, are equal to one and the same straight Trajection, the Trajection in the former case, must needs be made in a double proportion of time; because a double Space is taken to be run through by the same motive Force: But in the latter case it cannot; because when we take three equal things, viz. Time, Space, and the motive Force, it must necessarily follow, that supposing the same Space to remain, as much as the time is diminished, so much the motive virtue must increase; and that there be the same proportion of the space to the time, as there is of the motive virtue to the space: Therefore it must follow, that if the space be in such a proportion to the time, as 2 to 1, the force must be to the space, as 4 to 2; and therefore must not have the proportion to time of 2 to 1, but of 4 to 1.

VI.
Why Sticks
break after
that they
have been
long bent.

Some *Bodies* that have continued long bent, do break, when we endeavour to reduce them to their former posture; as we find in some *Sticks*, which break whenever we go about to straiten them again.

The Reason whereof is, because the *subtil Aether*, whilst it endeavours to separate the particles of *Bodies* that resist its motion, must not only overcome the Resistance of them, but of the *Bodies* that surround it. And forasmuch as every thing endeavours to continue in the state wherein it is, and that *Bodies* which have been once put into motion, do continue in the same; so it is that the *subtil Matter* cannot shake them, without superadding more force to them, and increasing their strength; and so it comes to pass, that dashing more strongly against the said parts, it altogether separates them from each other.

A *Bow* that hath been long bent, especially if it be made of *Wood* or *Steel*, doth in process of time lose its force of flying-back, and continues in the same state, to which by bending it hath been reduced. A long Plate of *Lead*, bent in manner of a *Bow*, doth not fly back at all, but continues in the crooked state in which it is put.

The Reason why a *wooden Bow*, that hath been long bent doth not fly back, is, because its parts are not so hard, but that the *subtil Matter* can easily form new pores in them for its own passage; but a piece of *Lead*, bent like a *Bow*, cannot start back: For seeing that the parts of *Lead* are soft and flexible, they do easily suffer themselves to be penetrated; so that the *subtil Matter* can easily form new pores, and being able to pass freely, doth not make any attack upon the parts, whereby it might cause them to fly back. For as drops of *Water*, falling perpetually, do make an impression even upon the hardest *Stones*; so by the continual impulse of the *subtil Matter*, against the sides of the *Oval pores* in the bent *Lead*, they are adapted and accommodated to the free admission of the said particles, so as to let them go through without any Resistance.

It is observed by some, that a *Bullet* discharged from a *Gun*, doth more penetrate a *Body* at 100 Foot distance, than at 10 or 20.

The Reason whereof is, because the *Bullet* being so soon beaten back, hath not space enough to perform so strong an effect: Something in the same manner, and for the same reason that a *Hammer* less flattens a *Bullet* when lying upon an *Anvil*, than when it is laid on a *Cushion*; as before was mentioned, Chap. 5. Of hard and fluid Bodies.

It hath been observed, that when a *Vessel* filled with *Liquor* is emptied into *Bottles*, and afterwards the *Liquor* is poured out of them into the *Vessel* again, it will not fill the *Vessel* as much as before; and that it is more conspicuous in *Wine*, than in *Water*.

The Cause whereof is, because the *Liquor* is not so much comprest in an open *Vessel*, as in *Bottles*; and because in the former the *Liquor* meets with nothing almost; but parts of its own Nature; whereas in *Bottles*, the parts of the *Liquor* meet more with the parts of the *Bottle*, which keeps them in, and compresteth them, that they cannot display themselves, as otherwise they would. As the *Liquors* are comprest by the Sides of the *Vessels* wherein they are contained; so likewise on the other hand are *Bodies* also comprest by the *Liquors* that are in them, but yet so as to be equally comprest in all the parts of them; because the parts of the *Matter* are kept in by each other in Equal poise, neither are they more preest in one place than in another.

For the same Reason it is also, that a pair of *Bellows* with the Sides of it clapt together held under *water*, the *Nuzzle* of it standing out, cannot be displayed or opened; forasmuch as the sides of it are comprest by the surrounding *water*, which will not give way, no not tho' great force be made use of for that purpose, especially if the *Bellows* be somewhat deeply sunk under *water*. Thus if you take a *Vessel* full of *Quick-silver*, and fasten to it a long *Pipe*, the top whereof stands out of the *Water*, it will be so comprest at the bottom

VII.
A Bow
that con-
tinues long
bent, at
last loseth
its force
of return-
ing to its
former
situation.

VIII.
Why a
Bullet doth
more pene-
trate a
Body at a
distance,
than one
which is
nigh to it.

IX.
Comprest
Liquors
take up
less Room,
than those
which are
put into
Vessels,
where they
are not
pent up.

X.
Why a
Bellows
held with
the upper
part under
water, can-
not be
opened or
displayed.

bottom of the *Water*, that it will cause the *Quick-silver* to rise somewhat in the *Pipe*.

XI. *Why the Air breaks forth with such violence out of those Pneumatick Vessels, wherein it hath been compressed.*
Air that hath been compressed in a *Pneumatick Engin*, breaks forth thence again with extream Violence; as is seen in those *Engins* which cast up *water* to a great height, or shoot *Darts* or *Bullets* at a great distance.

Some take the Reason hereof to be, that the *Air* being strongly prest upon, is received into some empty Spaces, which before separated the parts of *Air* from each other. But suppose it to be so, what is the Reason that when the Hole of the *Pneumatick Vessel* is opened, the *Air* breaks forth so violently? For if every part of *Air* retire it self into those empty Spaces, and preserves its former Extension, where is the Compression? And what is it makes the *Air* leap back with so much violence, if by being received into those empty Spaces, it does suffer no Violence?

The Cause therefore of this *Elastick virtue*, is, because the *Air* being thus compressed, its parts are not capable of dilating themselves as formerly: For being all of them flexible, and moving independently on their *Neighbours*, they must every one of them have, as it were, a little *Sphere*, which may be sufficient for them to perform their *Circular motion* about their own *Center* in. But being compressed, they can have no such *Sphere* or *Space* to move in, since every one of them enters into the other place, and so hinder one another. And whereas the force of the *Globuli* of the *second Element* continues still to be the same, and shakes the parts of the *Air*, as much as before; they with their *Extremities* hitting against each other, and driving one another out of their places, at last joyn their forces, and make a general onset to deliver themselves from the said Compression, and procure more room for themselves.

Hence it is, that the *Air* which is compressed in a *Pneumatic Vessel*, whereof I have given the *Figure* in the *Sixth Part* of my *Institution*, Chap. 14. having *water* at the bottom of it, doth violently break forth, mounting up to a very great height.

XII. *How it comes to pass, that the Air may be compressed in a Leaden or Pewter Vessel, but not in a Glass.*
Water contained in a *Glass* cannot be compressed, at least sensibly; which yet may easily be done, when it is in a *Vessel* of *Lead* or *Pewter*.

The Reason is, because the Compression of the *water* is always performed by the Expulsion of some *subtil Matter*, which lay hid in the *pores* of the compressed *Body*. Now because the *Air*, which is contained in the *water*, cannot pierce through the *pores* of the *Glass*, as it can those of *Lead* or *Pewter*; therefore this is the Reason, why *water* is capable of being compressed in a *Vessel* of *Lead* or *Pewter*. Thus we see not only, that *water* is squeezed out of *Wool*, *Sponges*, and other such like *wet Bodies*; but likewise out of *Green-wood*, and *Air* out of *Dry-wood*, when they are compressed by being put into *water*; as is apparent from the *Bubbles* arising to the Surface of the *water*.

XIII. *A Bladder that is blown up with Air, being compressed, returns to its former state of inflation.*
 A *Bladder* blown up, being compressed, riseth again.

Because the *particles* of the *Air*, which are shut up in the *Bladder*, being in continual motion, and whirling about their own *Centers*, they consequently cannot, without difficulty, suffer themselves to be compressed; and therefore as soon as the pressure ceaseth, they are extended again by the

Agitation of the *subtil Matter*, and consequently dilate the *Bladder*, as before.

From the same Cause it is, that a *Wind* breaking forth from the hollow of *Mountains*, doth with so much violence storm in the open *Air*; and that a *River*, where its *Banks* are narrow, runs with the greater force and swiftness: For the *wind* and *water* being compressed in those more narrow Spaces, do endeavour to deliver themselves from the Force that is upon them.

Hence it is likewise, that *Cloth* and *Leather* that hath been violently stretched out, return to their former Brevity; because many of their *pores* being straitned by that Extension, cannot suffer the *subtil matter* to pass through them, without a forceable and violent motion: Wherefore, as soon as the said violent Extension doth cease, the *pores* return to their former laxity; and the *particles* that surround the said straitned *pores*, by means of the *subtil matter*, are reduced to the bounds of their former Extension.

A *wet Finger* drawn about the Brim of a *Glass* full of *water*, or any other *Liquor*, first makes the *water* to wave a little, and to rise up in a small *Dew*, and being continued, will cause the *water* to leap over the Brim in great drops.

The Cause whereof is, because by this drawing of the *Finger* round the Edges of the *Glass*, the hard, but flexible parts of the *Glass* are pressed, and consequently the *pores* straitned, so as that they are no longer able to make way for the *Celestial matter* to pass through them. But as soon as the *Finger* is removed to other parts of the brim of the *Glass*, the *subtil matter* presently reduceth the *pores* of the before pressed part to their former wideness: And from this repeated compression of the *particles* by the *Finger*, and their Extension by the entering of the *subtil matter*, there is first caused an agitation of all the parts of the *Glass*; afterwards a swelling and waving of the *Liquor*; and lastly, the leaping up of the drops of it over the brim of the *Glass*.

The *Coarctation* and *Dilatation* of the *Pores* of a *Body*, do much contribute to its *Elastick force*.

Thus if we wipe the *Convex surface* of a bent piece of *Glass* with a *hot Cloth*; it will by this means become the more bent and crooked. But we shall find the effect contrary, if we wash the *Concave surface* with *Hot-water*, or wipe it with a *Hot-cloth*, for then its *Crookedness* will be diminished; because the *particles* of the *Fire* do dilate the *pores* of the *Glass*. This being much the same effect which we find, when having fill'd a *Glass Vial* with a long and narrow *Neck*, up to the middle of the *Neck* with *water*, we dip the same in *Hot-water*; whereupon we shall find that the *water* in the *Glass* will sink a little; because the heat hath dilated the *pores* of the *Glass*, and thereby made the *Vial* a little wider: But if you let it continue in the *Hot-water*, then the *water* which is in the *Vial* being heated likewise, will rise higher again: But the contrary will happen when you dip the *Vial* into *Cold-water*; for the *pores* of the *Glass* being straitned by the Coldness of the *water*, the *Liquor* in the *Glass* will rise higher.

XIV. *Why the Wind that is pent up in a narrow space, blows more violently.*

XV. *Why Leather that is extended by force, returns to its former length.*

XVI. *Why the drawing of ones Finger about the Brim of a Glass, makes the water contained in it to leap up.*

XVII. *The Dilatation or Coarctation of the pores of a Body, doth conduce to the Elastick force of it.*

XVIII.
What is
the Reason
why Glass
Drops,
when one
end of
them is
broke off,
the whole
immedi-
ately breaks
into small
Dust.

Figure 7.

Little bits of *solid Glass* are brought out of *Prussia*, which are commonly called *Glass-drops*; the figure of them somewhat resembling a long *Olive*, with a crooked Neck, not much unlike the *Retorts* Chymists use, save only that it is solid and without any Cavity, as is exprest in the figure A B. These *Glass-drops* were formerly made of a hard and thick sort of *Glass*, but are now made of *Cryſtal-Glass*, which being melted, and drawn out of the Melting-Pot with a *Glass-Pipe*, and being dropt into a *Pail of water*, becomes formed into these *Drops*, because of the *Clamminess* of the *Matter*. If these *Drops* be let fall into *warm-water*, the *Drops* will be better and more easily formed. Now it is a very wonderful thing to see a solid piece of *Glass*, which scarcely can be broke with the repeated strokes of a *Hammer*, yet when broke off a little above the end or point of it, or being filed in the more distant parts at 1 or 2, doth immediately break into small Dust, to the great admiration of the *Spectators*. When indeed the end or point of it 3 is broke, it does not always fall into Dust; but if the thicker part of the Neck 4 is broke or snapt off with a pair of *Pincers*, the whole Drop flies into small Dust, not without some noise.

This notable Effect cannot be assigned to any other Cause, than the *subtil matter*, which upon the breaking off of the Point 4, doth immediately rush into the pores of it with so much violence, that finding no out-let, it exerts its force upon the Neck of the Drop, and breaks it into the finest Powder. For seeing that this *Glass*, like a Drop, is at first of an *Oval figure*, and afterwards pointed, and at first drops into the *water* in greater quantity, and afterwards in a fine *string*, the pores that are in the Point of it, must needs be uniform and like one another; whereas those that are in its other parts must be as various, as being more remote from the *surface*: For the deeper they are in the *Glass*, the wider they are; and this, because the Point being so thin and slender, is uniformly condensed by the *water* inward and outward, and perforated by the *subtil matter*; whereas the thicker parts have their outsides cooled and condensed, before their inside. The utmost Point therefore 3, may be broken either with a *Hammer*, or with the *Hand*, without any pains or

wonder; but the other parts 4, or A, cannot be pierced with a *Bodkin* or *File*, before that the whole Drop fly into Powder with a great noise: For because of the straitness of the pores that are in the *surface* of it, and the dilatation of those that are about the middle, the *subtil matter* rushing vehemently from the middle of the *Glass* to the outsides of it, dasheth away the *parties* of the *third Element*. For Experience teacheth, that any *Glass* that is cooled after this manner doth fly to pieces in small *particles*: For the parts of the *Glass* that are about the midst of it, being wider, and growing narrower, as they approach to the *surface*; it must follow that the *subtil matter* penetrating the more narrow pores, doth dash against them with that violence, that it makes the *Glass* fly into small Dust.

But if this Drop be afterwards heated again in the *Furnace*, and suffer'd to cool by degrees, the now mentioned wonderful effect doth not follow; because in this case the foreſaid Pores are all uniform: According as we find it happens in *Steel*, which being a second time heated in the *Fire*, doth thereby acquire uniform pores throughout, still retaining the Hardness it had before. Wherefore also when the Point of it is broke off, there is no reason for its breaking into pieces, because the *subtil matter* finds its way open through the uniform pores of it. But the contrary happens, when being put into the *Fire*, it be not suffer'd to become red hot; for tho' then when the Point 3 is broke off, or the part 4, it doth not fly into Powder, yet if the breach be made nearer to A, the same effect will follow by the Reason before given.

It is observed, that all *Bodies* which are dilated by an *Elastick virtue*, do exert a greater force at the beginning of their *Dilatation*, than at the end of it.

The Reason is, because these *Bodies*, at the beginning, are supposed to be more compressed, than afterwards when they are more dilated. Now it is plain, that whilst they are more compressed, their *Elastick virtue* or *Spring* is so much the stronger, and they do the more endeavour to dilate themselves, so that they must needs exert a greater force at the beginning of their *Dilatation*, than in the progress of it.

XIX.
A Glass
Drop being
heated
again in
the Glass-
makers
Furnace,
and suffer'd
to cool by
degrees,
doth not
when broke,
fly into
Dust.

XX.
Pressed
Bodies
exert a
greater
force at
the begin-
ning of
their Dila-
tation, than
at the end
of it.

The

The Second Part

OF THE

HISTORY

OF

NATURE.

OF

QUALITIES.

CHAP. I.

Of Qualities in General.

I. Qualities, as they are commonly explained, are altogether unintelligible.

A Student of Philosophy ought to abhor nothing more than to assert things which he doth not understand, or to endeavour the Demonstration of what he cannot define. But yet there be many that are guilty of this fault, who endeavouring to defend the opinion of some of the *Antients* concerning Qualities, do attribute such a Nature to them, which we can have no conception of. For of what use is it to tell us, that a *Quality* is that whence things are said to be *Quales* or such like? What *Old Woman* is there that doth not know as much? Is there any *Country Fellow* so blockish, that doth not know that by *Whiteness* things are made White, and by *Redness*, Red? They would do much better to acquaint us wherein precisely the Nature of a *Quality* doth consist, how it doth affect the *Subject* it belongs to, and after what manner it is diffused through the same. Let the *Peripateticks* therefore in good earnest tell us, what *Representation* they frame in their *Minds* of a *Quality*, and trouble us no more with their *Words*, which serve only to darken and fully *Truth*. Is *Quality* any thing *Physically*, or really distinct from the *Substance* wherein it is? Or is it superadded to the things that are denominated from it, as some new *Entity*? Let them therefore explain its *Genuine Nature* to us, and do it in such a manner, as that what they express in *words*, may be intelligible to us. If they cannot do this, which indeed I suppose is a thing impossible for them, why do not they quit these frivolous *Qualities*, and following the *Laws* of *Nature*, espouse more *Intelligible Principles*?

II. Wherein the Nature of a Quality doth consist.

What is more *Intelligible* than *Quantity*, *Motion*, *Situation*, *Figure* and *Rest*? By which all natural effects may be made out, even the most abstruse and difficult of them. A *Watch* is moved, and without any outward force, measures and shews the *Hours*. A *Key* locks a *Door*, and

opens it. Is there any necessity to conceive a faculty in a *Watch*, that may set its *Wheels* a going? Or in a *Key* any thing really distinct from it whereby the *Lock* is opened? What *Man* in his wits will not confess that it is more consonant to Reason, to attribute the constant motion of a *Watch* to the *Steel Spring*, the disposition of the *Wheels* with their figure and contexture; and the power of shutting and opening that is in a *Key*, to the *Figure* and Ranging of its Parts; than to have recourse to *Qualities*, which they can never explain nor conceive? But this is to run out beyond what I have here designed, which is not to assert the Nature of *Qualities* by *Arguments*, but to confirm the same by *Experiments*.

The *Sun* hath a power to harden *Clay*, soften *VVax*, melt *Ice* and *Butter*, to resolve *VVater* into *Vapors*, to whiten *Linnen*, to tan the *Skin*, to ripen *Fruits*, to hatch the *Eggs* of *Fowl* and *Silkworms*, and sometimes to produce I know not how many various effects. All which are not any distinct *Powers* or *Qualities* in the *Sun*, but only the results of its *Heat*, which according to the different Texture of *Bodies*, and according to the different concurrence of *Cooperating Causes*, is variously determined.

The Purest *Spirits* of *VVine*, when joined with the most highly Rectified *Spirit* of *Urin*, become united together in the appearance of *Snow*, which is caused by nothing else but a new Texture of *Parts*: As when the *Spirit* of *Nitre*, mingled with detonated *Nitre* resolved per deliquium, is turned into *Saltpeter*. Or, as when the *Spirit* of *Salt* being beaten with the *VVhite* of an *Egg*, doth communicate to it hardness, which it had not before.

When the *Sea* is tost and beaten with *VVinds*, it changeth its *Colour*, and what was a *Seagreen* Colour before, does now appear *VVhite*; as the same is Elegantly described by LUCRETIVS.

As in the Sea when the mad Ocean Raves,
And white Curles rise upon the foaming VVaves.

Q q q q

Now

III. There are no Qualities in the Sun that are really distinct from it.

IV. The Difference of Bodies proceeds from the different Figure and Contexture of their Parts.

V. The Sea-water changeth its Colour by Agitation only.

Now who can be imagin'd so weak in his Intellectuals, as to attribute this change to any supervening *Quality*? For what Agent should effect this alteration? Or by what means could a real Entity be diffused through such a vast conflux of *Water*? The *Sea* therefore becomes *white* by being turned into *foam*, that is, by the variation of its parts in their *Magnitude*, *Situation* and *Figure*, and rising into little *Bubbles*; whence the reflected light being conveyed to our Eye, represents a *white* Colour.

VI. Thus, if *Mercury Sublimate* be put into hot water, and a few drops of *Spirit of Urine* dropt into it, and then filtrated, it becomes white like *Milk*. Thus *Red Lead* and *Coral*, by the infusion of *Oil of Tartar*, acquire a *white Colour*. Thus *Gold* being mixed with *Silver*, if afterwards it be separated by *Aqua Fortis*, a black Powder falls to the bottom, its first Colour being lost. Of which change no other cause can be assigned, than the *Figure*, *Texture* and *Order*, &c. of the Parts. For as *LUCRETIVS* expresseth it,

— In Bodies so,
As their Seeds, Figure, Order, Motion do,
The things themselves must change and vary too.

VII. Put water into a strong Pot or Vessel, and having luted its Cover to it, and let it stand for some time upon *Burning Coals*, then remove it, and let it grow cold; then set it to *boil* again as before; and you'll find that by the repeating of these alterations several times, the *Colour*, *Taste* and *Smell* of the water will be changed.

This change in the water proceeds from nothing else, but the new *Order*, *Figure*, *Position*, &c. of its parts. For the force of the *Fire* separating the particles of the *Liquor*, makes them to acquire another position than they had before, by which means different qualities are induced into the water, and they made to affect our senses in a different manner from that they did before.

VIII. How many sorts of *Plants* do we see grow out of water only, into which they shoot their *Roots*, and attracting it for their *nourishment*, do encrease in *weight*, grow up, and spread their *Branches*. And indeed it is a matter of wonder to see hot and *Cautstick Plants*, such as *Crowfoot* is, growing and encreasing in, and from the water alone; neither can this change be assigned to any thing else, but the meer change of the *Figure* and *texture* of the *Parts*. Thus from *churn'd Milk*, without any other accession of a new form, but by a pure transposition of *Parts*, *Butter* and *Buttermilk*, are produced. Thus *Glass* is made of *Sand* and *Salt*, and *Roman Vitriol* of *Salt* and *Copper*; for as *Sand* gives *Glass* its firmness, so *Copper* or *Iron* afford the same to *Vitriol*.

IX. And for the same reason it is that *Oysters*, in the hottest *Months* of *Summer*, have the appearance of *Blood* in them; which Colour towards the approach of *Winter* vanisheth, because then for want of *heat*, the *Oysters* cannot concoct the *Alimental Juice* to that high degree, as to produce *Blood*. And suitably to this *Physicians* tell us, that the *Redness* of the *Blood* proceeds from the acidity of the *Vital Saline Spirit*; much in the same manner, as *Fuleps* by the instillation of a few drops of *Spirit of Vitriol*, acquire a *Red Colour*.

If you drop a few drops of *Oyl of Tartar* into an infusion of *Sena-leaves* in warm water, the water will presently turn *Red*, and become of a purple Colour, tho' there be no such Colour, either in the *Water*, *Leaves*, or *Oyl of Tartar*.

The Cause of which *Redness* is, for that the *Oyl of Tartar*, piercing into the substance of the *Sena*, doth so agitate and separate the parts thereof that it makes way for the most minute particles of the water, to enter the *Pores* of the *Sena*; and changing their *Texture*, make the Beams reflecting from them to exhibit to our Eye a *Red Colour*. And that this *Redness* is by this means produced, may be plainly evinced, because another *Oyl*, for instance, that of *Vitriol*, being infused in the said water, will not produce the same effect; because it wants the power to penetrate the substance of the *Sena*, and separate its parts so, as to make way for the *Particles* of the water to enter.

And the same may be applied to other *Qualities*, as *Heat*, &c. for our *Touch* assures us, that there is an extreme heat, in *Stygian waters*, or *Corrosive Chymical Spirits* when *Metals* are dissolved in them. And in the *Spirit of Nitre*, poured upon the butter of *Antimony*, or the filings of *Lead*; when yet the said *Corrosive Spirits* as well as *Metals*, are both cold.

An *Apple* when dash't against another *Apple*, or when bruised by falling down to the *Ground*, or being thrown against a *Wall*, that part of the *Apple* which is bruised will be found to differ from the rest in *Smell*, *Taste*, and other *Qualities*; and this change is so great, as that it seems to be quite of another nature, than the other part of the *Apple*.

Which change proceeds only from the Transposition of its *Parts*, for no new thing is superadded to it by its bruise, but only the parts of the *Apple* are altered from the Position they had before. So likewise we see what a great change is produced in *Vine*, when it is changed into *Vinegar*; of which notwithstanding no other cause can be assigned, but a slight exhalation of some of its minute parts, or rather the change of their *Configuration*, by being shaped into little pointed *Swords*. And as by the exhalation of some parts this change is caused in *Vine*, so no less an Alteration of things is often produced, by an accession of new parts.

Thus an *Apple* or *Pear*, by being rolled hard upon a *Table*, doth grow soft, and of a sweet *Taste*, by a gentle distribution of the *Spirits* into all the parts of it, as the *Chymists* express it, the unequal Distribution whereof is the cause of a *harsh* and *sour Taste* in *Fruit*: For hard Rolling is a mean between *Concoction* and simple *Maturation*. But of this we shall treat more largely in the Part concerning *Plants*.

CHAP. II.

Of Heat.

Water, which when cold is without motion in a Pot or Kettle, when it is hung over a Fire and boils, riseth up to the brim of it, when as before it scarcely filled one half of it.

The

X. Oyl of Tartar drops into an Infusion of Sena-leaves, changes the colour of it.

XI. Why two cold Bodies mingled together do sometimes produce heat.

XII. An Apple thrown against a Wall, doth acquire new qualities in that part where it hath been bruised.

I. Why boiling water riseth up to the very brim of the Vessel, when before it reached only half way.

The Reason is because the *heat* of the *Fire* doth put the parts of the *Water* into *Motion*, and separate them from each other, and is the cause why by reason of the admission of *Air*, or some other insensible matter, they can no longer be contained within the same bounds as they were before, but require a greater space for them to display themselves in. For it is common to all *Bodies* that are rarefied, to encrease in bulk by the reception of the *subtil matter* into their *pores*; and more especially where the *Rarefaction* is caused by some considerable *Heat*, which puts the parts into *Motion*, and separates them from each other.

II. Why the heat of the Sun is commonly vivifying and vegetative, and that of the Fire destructive.

The *Heat* of the *Sun* promotes the vegetation and vivification of *things*; whereas the *heat* of the *Fire* is rather destructive, and generates nothing by its activity.

The Reason whereof is, because the *heat* of the *Sun* is moderate, and because of its distance and perpetual circling about the *Earth* very gradually dispenst. Whereas the *heat* of *Fire*, because it cannot reach far, and before it can produce any considerable effect, must approach nearer to *Bodies*, than is for their preservation, doth presently vanish, and either through the ignorance, or impatience of *men*, cannot be kept in that temperature which is necessary to the vegetation of *things*. But if so be, it can by the Art and Industry of *Men* be reduced to a due Temperature, then nothing will hinder but that *Eggs* may be hatched by it, *Plants* produced, *Insects* generated, and all *living things* cherished by the warmth thereof.

III. A thing that is Lukewarm only, seems hot when touched with a cold Hand.

A *Lukewarm Body*, touched with a *hot Hand*, seems *cold* to us; and *hot* when we touch it with a *cold Hand*.

Which different *Sense* doth not proceed from the thing that is *Lukewarm*, but from the *Hands* that touch it; for tho' the same force be in the *Lukewarm Body* to agitate both hands; yet because the commotion of the parts of the *hot Hand*, doth exceed the Agitation that is in the parts of the *Lukewarm Body*, it makes the *heat* of the *Lukewarm Body* to appear or feel *cold*. For the Agitation of the *Particles* of any *Body* considered in themselves, is not called *heat*, but only so far as it affects our *Sense of Feeling*.

IV. Why the same Baths are sometimes judged hot, and at other times cold.

So they who enter *Baths* distinguished by different degrees of *heat*, having continued for some time in those that are *Lukewarm*, before they enter those that are *more hot*, find that that *water* which at first was so *hot*, that they could scarcely bear it, doth now seem *cold* to them; because their *Body* being thorough *hot* by the heat of the *Baths*, can no longer be affected by a *weaker heat*. Neither is it to be questioned, but what seems to be *hot* with *Scythians*, who live in a very *cold Air*, would be esteemed *cold* to *Ethiopians*, that live in a very *hot Climate*.

V. Cellars and Caves under ground, are not hot in Winter-time.

Wherefore 'tis a *mistake* in some, who conceive that *subterraneous places*, as *Cellars*, and the like, are *warmer* in *Winter*, than in *Summer*: seeing that this difference of *heat* proceeds only from our *Body*, which is differently affected in *Winter*, from what it is in *Summer*: And we do not mind that the same thing may appear *cold* to one that is *hot*, and on the contrary, *hot* to one that is *cold*. For if it be so indeed, that *Subterraneous Caverns* are *hot* in *Winter*, whence is it

that the *Oyl* that is kept in them congeals, which it doth not in *Summer*, when yet they appear to be *cold*? *Subterraneous places* therefore are judged to be *hot* in *cold weather*, because our *Bodies* are *cold* when we enter into them; and in *Summer*, *cold*, because at that time our *Body* is *hot*.

A *Molten Metal*, and especially *Gold*, burns more strongly than the *Flame* whereby it is agitated, and whence it is put into its *heat*.

This proceeds from the compactness and closeness of the parts of *Gold*, which being fat and thick, cannot be dilated, or very little, which is the reason that it both *burns* more vehemently, and retains its *heat* longer. For the *particles* of the *Fire*, are as it were shut up in the *Gold*, without being able to disentangle themselves. Whence it is that a *Man* cannot touch *Gold* in *fusion*, with his *Hand*, but that the *Skin* of it will be shrivel'd up and burnt immediately. And on the contrary, *Iron* produceth a greater *heat* in *Aqua-fortis*, than *Gold* it self doth, because this *Liquor* enters the softer parts of *Gold* with less force and violence. For the same Reason *boiling Oyl* burns more violently than *Water*, because of the Connexion of its fat and unctuous parts, which do more tenaciously keep the *particles* of *Fire* enclosed, and suffer them not to get away.

A *Nail* struck with a *Hammer*, and driven into the hardest *wood*, doth not feel *hot*, whilst it is entering the *wood*, but is only perceived to grow *hot*, by those strokes of the *Hammer* that light upon it, after that it is driven home.

The Reason hereof is evident from the Nature of *Heat*, which doth not consist in the direct motion of *Bodies*, but only in the Agitation of the *Insensible Parts*. So that it is apparent, that the *Nail* cannot be *heated*, as long as the *whole* of it is in motion, and is entering the *wood*; but when it is driven home, the *Strokes* that afterwards light upon it, put the insensible *particles* of it in motion, wherein the nature of *heat* consists. But the contrary happens when *wood* is sawed with a *Saw*, or bored with an *Auger*, because then the *Saw* and the *Auger* grow *hot*, and not the *Wood*, because in this case the insensible parts of the *Saw* and *Auger*, are moved and not those of the *wood*.

When a piece of *Iron* is filed, it is observed that it will grow *hot*, but the *File* remain *cold*.

The Reason is, because the *File* excites a great commotion in the parts of the *Iron*, which produces *heat*. And tho' the parts of the *File* do suffer the same force, as the parts of the *Iron*, yet because they are much longer than it, they do not with the very same *Teeth* touch the same part of the *Iron* twice; but there is always some space of time between the gratings of the parts of the *File*, during which, that part of the *File*, that began to be heated, loseth its heat again.

So likewise the *Axeltree* of a *Coach* or *Cart* grows *hot*, and not the *Iron-plate* that goes round the *Wheel*, because tho' it describes greater lines, yet are not its parts agitated amongst themselves, like that part of the *Wheel*, which rubs continually against the *Axeltree*. Because the Effluence of *heat* doth not consist in the swiftness of the motion, wherewith any *Body* is moved, but in the violent and various agitation of the insensible parts of

VI. Why Gold burns more violently than Fire.

VII. Why a Nail does not grow hot by the strokes of a Hammer, till after it be driven home.

VIII. Why the Iron that is Filed grows hot, and not the File it self.

IX. Why the Axeltree grows hot, and not the Iron Plate that is on the Wheel. And why the Bullet discharged from a great Gun is not heated.

of Bodies. Thus the Bullet discharged from a Great Gun, and most swiftly moved, doth not burn the wood which it penetrates, nor the Bullet discharged from a Cross bow, doth not fire a dry piece of Linnen that it is shot through; because tho' both these Bullets, be most swiftly moved, yet are not their parts put into any agitation.

X.
Why the
Breath we
breathe
forth with
our open
Mouth is
warm,
whereas
that which
we put
forth with
more force
through our
almost shut
Mouth, is
cold.

The Breath we breathe with open Mouth into our Hand doth heat it, but if we blow it forth with vehemency through our Mouth almost shut, it is cold, and cools, suppose hot Pottage, or any thing else.

Our Breath causeth heat, when it is breathed forth gently, that is, when it consists of parts variously agitated, and when it unequally lights against the hand. For the heat of Bodies is nothing else but the various determination of their insensible parts, whereby they are moved this way and that way. But the Breath we blow from our Mouths, drives out the heat from any Liquor; because it is swift and determined to one part only: For by this means the most subtil parts of the Liquor, cannot separately continue their own proper motions, because they are all driven and determined by the blast of our breath to one part; as the motion of all the parts of a River is determined one way.

XI.
Why
Quicklime,
and some
other Arti-
ficial Stones
grow hot,
when sprink-
led with
water.

Quicklime grows hot when water is cast upon it, to that degree, that it burns more violently than a Flame.

The Reason is, because the Pores of the Lime-stone which before only were open to the passage of the Globuli of the Second Element, have been more dilated by the Fire; so as that afterwards they were free to admit the particles of water also, but yet only such of them as were surrounded with the matter of the first Element, which rushing against the hard Particles of the Quicklime, do shake and separate them, especially if there be any store of them, and they do from divers parts, rush against one and the same part of the Quicklime. And in like manner we see that an Artificial Stone made of Pitch, Tarr, Tartar, Brimstone, Saltpeter, Sarcocolla, and Oyl of Peter, equal parts, and as much Quicklime as all of them, mixed with the Yolks of Eggs, and kept for some days buried in Horse-dung, if it be sprinkled with fresh water doth break forth into a flame.

XII.
Why the
heat of
Quicklime
exceeds the
heat of a
Flame of
Fire.

The heat caused in Quicklime, by the asperision of water, is more violent than the flame that proceeds from Fire, because the Quicklime consists of branchy particles, which when they are separated from them the matter of the first Element, which surround the particles of water, do violently strike the hand, piercing and rending the Skin like so many Needles. And for the same reason a Coal, whose parts are intangled with long and various branchy parts, produce a greater heat than Flame doth. Thus melted Metal, and more especially Gold, burns more strongly than Oyl, and retains its heat much longer; because Gold consists of a more close and compact unctuous matter, and therefore is less subject to be dilated, and to let the particles of Fire it hath received to fly from it.

XIII.
Why a Red
hot Iron is
made use of
for the cut-
ting of
Glass

Glass is commonly cut with the Edge of a red hot Iron, or with a Packthread dipt in Brim-

The Reason whereof is, as was before said, that the parts of the Glass being agitated by the heat, require more room, and therefore drive the neighbouring Bodies from them. For it is impossible that the parts which are heated, should move swiftly and circularly, without taking up more space. This is evident, as in all other Bodies, so even in the most compact Bodies of Metals, which do somewhat swell, and become distended by heat.

Liquors, that of themselves are cold, when pour'd together produce a great heat. Thus Spirit of Vitriol added to Oyl of Turpentine, grows very hot. It hath been also observed that Spirit of Wine, by degrees added to Aqua-fortis, or Spirit of Nitre, doth cause a great and lasting heat.

Which Heat is caused from the diversity of the parts whereof the Liquors do consist; as being of such Figures, as that upon their mixture, they can the better join together, than when they are separate and by themselves, and that in this closing together, they swim upon the matter of the First Element, at least at the time that they are perceived to boil or effervesce. Which may be confirmed from hence, that after their ebullition is ceased, it is evident that many of them are grown together, constituting several hard Bodies. In the same manner, Oyl of Vitriol, when cold water is pour'd upon it, grows hot; and Aqua-fortis into which Salt Armoniack hath been infused, doth contract a heat, by casting into it some bits of Brimstone. Thus the Spirit of Salt Armoniack and Tartar, and the Filings of Lead, or the Oyl of Vitriol, and the Filings of Steel joined together are productive of heat. And which may seem more wonderful, Ice it self being put into the Oyl of Vitriol, causeth so great a heat, as to send forth Smoke. And so Fruits also, as Cherries, when put into Spirit of Nitre, produce a considerable heat.

We must not here omit a notable experiment, which is, that if you mix half a pound of Flower of Brimstone, with the same weight of Filings of Steel, and put this mixture into cold water, stirring it now and then, it will cause so great a heat, that the vessel will be too hot to be touched. Thus Quicksilver prepared after a peculiar manner, and amalgamated with Gold, doth give such a heat, that it cannot be endured.

In like manner the Stone MAGNESIA, which in hardness resembles the Leadstone, when put into the Oyl of Vitriol, stirs up a great heat, which is encreased by repeated affusions of water, and like Iron communicates a Red Colour to the Aqua-fortis, sends forth a sharp and stinging fume; and when some of it is put upon Molten Glass, presently the Glass swells, which is common to it with Copper and Iron. Thus if you cast a little Filings of Brass into a great Bottle, in which there is only a small quantity of Aqua-fortis, there follows such an effervescence, that the Bottle seems to be full, and produceth so great a heat, that the Bottle cannot be touched.

Sometimes two hot Bodies mingled together, produce a third of a different Nature: For if you pour the Spirit of Nitre, which is very hot and piercing, upon Lixivous Salt, the product of this conjunction will be Saltpeter, which cools rather, than is productive of heat.

XIV.
How Heat
comes to be
produced
by two cold
Liquors
mingled
together.

XV.
The ming-
ling of
Brimstone
with Steel,
produceth
Heat.

XVI.
The Stone
Magnesia
dissolved in
Oyl of Vi-
triol, pro-
duceth
heat.

XVII.
Two hot
Bodies
mixt to-
gether, pro-
duceth
sometimes
a third,
that is cold.

The

CHAP. III.

Of Cold.

The Cause whereof is, because the *particles* of *Nitre* and *Salt* become so intangled together, as that they lose their sharp points, whereby before they were used to dissolve *Bodies*. For the *Bodies* of the *Nitrous Spirit*, which before were volatile, and were easily sent away into the *Air*, being now kept down by the fixt *Salt*, can no longer fly away. And therefore it is no wonder that the *Spirit* of *Nitre* loseth the power of *heating* which it had before, and ceaseth to be Corrosive.

XVIII.
How Snow
comes to be
condensed
by heat.

Notwithstanding that, it is the property of *Heat* to rarefie *Bodies*, and by loosning of their parts, to make them take up more room: Yet, for all that, we find that it doth condense *Snow* and *Clouds*. The Reason whereof is, because the *filaments* of the *particles* of *Ice*, whereof *Snow* doth consist, being more thin and slender than the middle part of them, they are consequently upon the approach of *Heat*, more easily dissolved, and bending themselves this and that way, because of the agitation of the *subtil matter* that surrounds them, they embrace the neighbouring *particles* of *Ice*, without quitting those they were intangled with before; and by this means constitute a more compact *substance* than they did before.

XIX.
The same
effect is
produced
by heat in
the Clouds.

This effect is still more clearly discoverable in the *Clouds*; for since the *particles* of *Ice*, whereof they consist, are at a greater distance from each other, and leave greater *Intervals* between them, they cannot approach to their neighbouring *particles*, but that at the same time they must be separated from some other; and therefore when they are bent, must needs take up less room, and consequently constitute a more close and compact *Body*.

XX.
Heat turns
Lime and
Ashes into
Glass.

Lime and *Ashes*, by the heat of the *Fire*, are turned into *Glass*: For the *Crystal Glasses* of *Venice* are made of *Stones* which are found near the River *Ticinus*, and brought from *Pavia*, with an equal quantity of the *Ashes* of an *Herb*, which the *Arabians* call *Kall*, and which grows in the Desert between *Alexandria* and *Rosetta*.

The Effect of reducing these to *Glass*, is never produced, but by a long continued *Fire*, and that in the highest degree: For seeing that the *particles* of *Lime* and *Ashes* are thick and irregular, they cannot so lie upon one another, as to stick or cleave together. Wherefore a *strong Fire* must be employed, to exercise its activity upon them; for then, whilst the thinner *particles* of the *Third Element*, together with the *Globuli* of the *Second Element*, are laid hold of, by the matter of the *First Element*, and proceed to move most swiftly about them, their Corners are by little and little worn off, and their *surfaces* being made more smooth, and some of them bended, flowing over one another, they no longer touch each other now in some points, but are joyned with their whole *surfaces*, and so sticking together, constitute that *Body* which we call *Glass*.

NO *Body*, how cold soever it may seem to the Touch, is wholly devoid of *Heat*. For *water*, which to our sense is most cold, is proved not to be destitute of all *heat*, because of the *Vapours* and *Steams* which we see do arise from *Rivers* and *Pools*, even in the *Winter* time, and in the *Night* time.

The Reason is, because *Cold* is nothing else but the want of *Heat*; and as *Darkness* is the privation of *Light*, which is the companion of *Heat*, or the effect of it; so *Cold* seems to be nothing else but a privation of the said *Heat*; and therefore that which we call *Cold*, is nothing else but a more remiss degree of *Heat*.

It happens sometimes in very *Cold Weather*, that *Mens Hands*, and other parts of their *Body* grow numb'd; which when they come near the *Fire*, are seized with very sharp pricking and shooting pains.

The Reason whereof is, because the *particles* of *Fire*, being in continual motion, do with violence run a-tilt upon the Nerves of the Hands, or other Members that are benumb'd with cold, and wound them as it were with so many pointed *Lances*. Which *Vellication* of the *Parts* cannot be without causing great *Pain*. Wherefore to restore a *Hand* benumb'd with cold, we must not presently expose it to the *Fire*; but first gently rub it, and endeavour to bend and move the Joints, that by this means the chased *blood* may be recalled, and the parts that were asleep or benumb'd, may again come to themselves. Wherefore in *Swedeland*, *Denmark*, and other cold *Countries*, when any one chanceth to be thus benumb'd with cold, or in danger to be seized with a *Gangrene*, they presently put the part into cold *water*, or *Snow*, for by this means the *pores* that were shut up by the cold, are opened by degrees, and make way for the banisht *vital Spirits* to return to them again, whereby the parts are soon after recovered to their former state.

Thus *BARCLAY* tells us, that when King *JAMES I.* was in *Denmark*, and that by the cold, the end of his *Nose*, and the *Lappets* of his *Ears* were become without all feeling, and almost mortified, he by the advice of the *Inhabitants*, applied *Snow* to them, to preserve them from a *Gangrene*.

The Reason of this cure of frozen and benumb'd parts is, because the grossest matter of the *Second Element*, which got out by their *pores*, when the cold began to shut them up, cannot re-enter again, in order to restore to those parts their former softness, without destroying their connexion, which might cause a mortification or *Gangrene*, which is avoided by rubbing the parts with *Snow*, because the *Snow* contains nothing in its *pores* besides the most subtil matter of the *Second Element*, which is very proper and fit to open by degrees the *pores* of the congealed parts, till they be wide enough to let the more gross matter of the *Second Element* pass through them also.

I.
No Body is
altogether
destitute of
Heat.

II.
Why a
Hand be-
numb'd
with cold,
when held
to the Fire,
is seized
with ex-
tream pain.

III.
What hap-
ned to K.
James I. in
Denmark.

V. Neither can any other Reason be given, why *frozen Apples* being put into *cold water*, are restored to their former condition, than that the *cold water* doth gently dissolve the congealed *Humour* in the *Apples*, and consequently causeth that effect of the *Cold* to cease.

V. During the most violent *Cold* of *Winter*, the *Air* is most thin and serene; but when the *Cold* is more remiss and moderate, it is generally *Misty*.

The Reason whereof is, *First*, because extreme *Cold* doth more condense the thick *Vapours* of the *Air*, and by this means makes them to fall down, and consequently leave the *Air* more clear and serene than it was before. *Secondly*, Because extreme *Cold* shuts up the *pores* of the *Earth*, by which means the *Vapours* are hindered from exhaling thence, and darkning the *Air*. Whereas *moderate Cold* produces a *cloudy* and *misty Air*; because the weak *Heat* which is joyned with that *Cold*, raises up *Vapours* from the *Earth*, which it is not strong enough to discuss or dissipate.

VI. Some *Bodies* never quit their *Coldness*, as *Marble*, and such like, which in the *hottest season* of the year feel very *cold*. So likewise *Ice* retains its hardness in the *Summer*, and is as *cold* then as in the *Winter*.

These familiar Instances make out, that *Cold* is nothing else than *Rest* or privation of *motion*. For the parts of *Cold Bodies* do cleave and stick fast together, so as to constitute a most close and compact Compound. But how doth it come to pass, that *Marble*, *Ice*, and other *Bodies* of like Nature, do preserve their *Coldness*, at all *Seasons*, in the same intense degree?

I Answer, That this proceeds from the *Heavenly Globuli*, which penetrate their *pores*; for the largest of them being endued with a stronger force of moving, do produce *Heat*: Whereas the lesser of them, which are inferior in Force to others, do communicate *Cold* to *Bodies*, as will appear from the Experiment. *Marble* therefore is thus *Cold*, because the *pores* thereof are so strait and narrow, that they can only admit the very least *particles* of the most *subtil Body*, excluding the greater that cause *motion*. And forasmuch as *Water* does never freeze, except when the Matter which runs between its parts is more subtil than ordinary, it so happens that the *pores* of *Ice*, which are then formed according to the bigness of these *particles* of the most *subtil matter*, by this means become so narrow, that they shut out those *particles* that are never so little greater. And this is the reason why *Ice* continues to be most intensely *cold* in the midst of the greatest *heats* of *Summer*. This also may be perceived by the Dissolution of it; for *Ice* doth not melt like *Wax*, whose flexible *particles*, give way to the Agitation of the *Fire*, and by the force thereof are separated: For the narrowness of its *pores* hinders the *Heat* from entering to its inward parts, save only as the outsidess of it melt away, and are broken by the force of it.

VII. Put some *Water* into a *Glass*, and lay *Snow* mixt with *Salt* round about it, so as to touch the sides of the *Glass*; and as soon as the *Snow* and *Salt* begin to dissolve, the *water* will be turned to *Ice*, not only in the *winter* time, but at any other time of the year.

The Reason of this Experiment is, because the greater *Globuli* of the *second Element*, which by their agitation are the cause of the *waters* fluidity, being of more force than those which run betwixt the parts of the *Snow*, and finding a more convenient place for themselves to move in, the stiffer and smoother *particles* of the *Salt* and *Snow* do necessarily tend that way: And forasmuch as Nature doth not admit a *penetration* of *Bodies*, and that all *motion* is performed by means of a *Circle*, the lesser *Heavenly Globuli* contained in the *Rain* and *Snow*, upon the approach of the greater, strive to get out, and to return to the places they have left, through the *pores* of the *Glass*. But because these *Globuli* are not sufficient to continue the motion of the *water*, consequently thereupon it becomes congealed, and acquires the coldness and hardness of *Ice*. And on the contrary, the *Snow* mixed with the *Salt*, dissolves and runs to *Liquor*, because it is agitated by the greater *Globuli*, which before, by their motion, kept the *water* liquid.

And probably it is for the same Reason, that *Spirit of Wine*, which is hot of its own Nature, doth cure Inflammations and the *Squinzy*; and also cools and heals the part that is scorched with *Gunpowder*; viz. because the *Spirit of Wine* hath its *pores* so disposed, that being applied to the enflamed part, it only admits the lesser *Globuli* of the *second Element*, which by their more remiss and soft agitation of the parts, do assuage the pain.

Thus the Inflammation of the *Emrods* are cured with a *Toasted-Onion*, or fulminating *Gold* mixt with *Brimstone*. For the Juice of the *Onion* being very sharp, with a mixture of *Sowness*, as *Salt Armoniack* and *Tartar* also are, which enter the composition of fulminating *Gold*, draw forth from the part affected, the *Humour* that is analagous with them, and mixt with it. It is a thing also owned by *Physicians*, that *Diseases* of *Men* may be communicated to *Animals*, by reason of the analogy of parts. Thus Mr. BOYLE tells us of a *Potters Son*, that was cured of the *Kings-Evil* by a *Dogs* often licking of it; the Disease having been by this means transplanted in the *Dog*.

Cold doth great harm to *Plants*, and if we may speak with the Ancients, doth scorch and burn them up like *Fire*.

This indeed is commonly ascribed to *Cold*; but if we diligently weigh the matter, we shall find that according to Truth it can be no more than the remote cause of this effect; because it rather proceeds from the *Heat* which follows upon the breaking of the *Frost*. For seeing that the *heat* cannot enter the *pores* of the *Plants* that are shut up by *frost*; neither can it restore to their inward parts that degree of *softness*, which they had before their congelation; since the said *Frost* hath spoiled the connexion and situation of the other parts, and therefore there cannot but follow an entire change of the whole, that is made up of these parts.

But yet sometimes it happens, that some certain parts of *Plants*, do without hurt endure *Cold*, as when the *pores* of *Plants* are shut up by *Cold* before that they begin to bud; for before that time they do not so much abound with that watry Juice, and their *pores* however narrowed by *Cold*, are

How frozen Apples may be restored to their former state.

Why the Air is so exceeding clear in Extream cold weather.

Marble in the Heat of Summer retains its Coldness.

How water by means of Salt, may be turned into Ice.

VIII. Whence it is that the Spirit of Wine doth cool.

IX. Diseases cured by Likens and Sympathy.

X. Colicis very hurtful to Plants.

XI. Why sometimes the contrary happens.

are still open enough to give entrance to the subtil matter that may agitate the parts. For it is not necessary that their contexture should be destroyed by it, which are the first that bear the onfet, before the Inward parts be set upon.

The Air that surrounds a cold Body, as Marble, is colder than that which is farther from it.

The reason whereof is, because scarce any but the most subtil matter hovers about Marble, either that which is about to enter the pores of it, or which flows out from it: And because this subtil matter, because of the tenuity of its parts, is not able to move the thicker particles of the Air, that might cause the Sense of Heat in us; for this Cause it is that the circumambient Air is perceived to be cold.

And it seems to be for the same Cause, that a cool Air is perceived about those Fountains, whence the water leaps up with great force; viz. because the thicker parts of the Air, which serve to excite Heat, are seized, and carried away by the water gushing forth, so that nothing but the Ethereal matter is left there.

When Water, or Spirit of Wine, tinged with a Red or other Colour, is put into a weather Glass; this Liquor doth of it self rise or fall, according to the coldness or heat of the Weather.

The Peripateticks assign the Cause of this Effect to be the condensation of the Air, which is in the upper part of the Pipe; and that thereupon the water is forced to move upwards, that it may fill up the Empty space which the Air hath quitted. But what, shall we conclude then, that an insensible Body, such as the water is, can be so solicitously concern'd for the good of the Universe, that left Nature should suffer a Vacuum, it rather mounts upwards, in downright contradiction to its own ponderosity? Wherefore they speak with a great deal more of probability, who say, that in Weather Glasses the Air is condensed, and the water driven upwards by the incumbent weight of the Air. For in these Glasses the Elastic virtue of the shut up Air is very much lessened, by which means the Circumambient Air does more press the Water, than the Spring of the pent up Air can bear.

Water is dilated by Frost, and takes up more space than it did before, whereof we have an evident instance in a Glass-vessel with a long Neck, for when we expose such a Vessel fill'd with warm Water to the Winter cold, the Water will sensibly sink down or decrease, until it be come to a certain degree of Coldness: And not long after, it will begin to swell again and mount upwards till at last being bound to its good behaviour by Frost, it stands still and remains immoveable.

The cause of this Rarefaction is, because the particles of the Liquor that are shut up in the Glass, before they begin to be Frozen by Cold, grow Stiff, by reason of the lessened Motion of the subtil matter, and take up crooked Figures; and therefore cannot cleave so closely together, as when they were soft and pliable. And hence it is, that being vehemently shaken by the subtil matter, they cannot reduce themselves to so narrow a room as they had before, but require a larger wherein to dilate themselves.

It is worth our observing, that Frozen Water by reason of its Dilatation does commonly break the Glass-vials wherein it is contained, especially if the upper part be Frozen first: Because the Water being dilated by Frost, sticks fast to the sides of the Glass; so that when the Water that is under it comes to be congeled likewise, it breaks the Glass, because it finds no room wherein to expand it self. But we find a quite contrary effect, when Water is Frozen in the bottom of a Vessel, first by Snow and Salt laid about it. For then the upper part of the Water doth by little and little mount higher, and by this means prevents the breaking of the Glass.

Wherefore it is no wonder, if sometimes great Vessels of Marble are broken by the freezing of the water that is contained in them, which Cælius tells us he hath been an Eye-witness of: Nay, what is more, Artificers sometimes find by Experience, that some of their Copper Vessels have been broken for no other cause. It is also an Observation of the Noble and Ingenious Mr. BOYLE, that the space of Frozen water hath been increased a ninth or tenth part more than it was before; for else, how could it be that Iron Pipes, such as are made use of for great Guns, fill'd with water, and shut up with the greatest care and industry, should break by being exposed to the cold Air? As hath been often experienced in England, and other parts of Europe.

Neither must it seem any strange thing to us, that the subtil matter should not be able to bend the stiff particles of the water, when yet it hath force enough to move them; forasmuch as a lesser Force is required to move Bodies, than to bind them: For we can easily with our Hand thrust a Bar of Iron out of its place, but find our selves altogether unable to bend it.

This will also inform us with the Reason, why the Ground that is frozen riseth higher, and bursts into many flits, to the great damage of tender Plants, whose Roots are often pluckt up; except these Chinks in the Ground be cover'd either with Snow, or some seasonable warm Rain. For the Frost raiseth and distends the particles of the Earth and Water, and so makes them take up more room, than if they continued in their Natural figure.

As it is the property of Cold to Rarefie the Water, so it is endued with another quite opposite to this, which is that of condensing almost all hard Bodies. For as Heat rarefies Bodies, by making their parts that are circularly moved, to remove somewhat farther from each other; so Cold, which is opposite to it, is the Cause why these Bodies are condensed, by keeping their parts at Rest, or by making them lose the determination of their Circular motion. Thus we find by Experience, that the most hard and compact Bodies, such as Metals, Glass and Marble, do sensibly contract themselves in hard Frosts, and become more brittle than before, and upon a Thaw return to their former state.

It is also from the same Cause that men, who swim in Cold water, or otherwise affected with the Circumambient cold Air, are almost continually provoked to make Water; because the Contraction, which is an effect of the Cold, is communicated to the Bladder, and so causeth the

XVI. Why water freezing in a Glass, does sometimes break the Glass, and at other times not.

XVII. Why sometimes very strong Vessels are broken by the freezing of the water that is contained in them.

XVIII. What the Reason is of the stiffness of the Particles of Ice.

XIX. Why the Ground that is frozen riseth higher.

XX. Cold also Condenses hard Bodies.

XXI. Great Cold provokes frequent voiding of Urine.

XII. Why a cold Body, such as Marble, cools the Air that is near it.

XIII. What is the Reason of the cold Air that is about Fountains.

XIV. Why Cold makes the water in a Weather-Glass to mount upwards.

XV. The Frost rarefies water.

lift to make *water*. And therefore if the *Hand* of one that is fast *asleep* be dipt in *Cold water*, it causeth him immediately to let go his *water*. And for the same Reason it is, that those who come out of a *warm Bed*, as soon as their *Bodies* come to be exposed to the *cold Air*, find themselves to stand in need of *making water*: For as soon as the motion of the *particles* is allayed by *Cold*, and the parts thereby contracted, the same is also communicated to the *Bladder*, which thereupon endeavours to rid it self of its burthen.

XXII.
How it comes
to pass,
that Ice
can be pre-
served
whole and
entire all
the Sum-
mer over.

Ice may be so preserved, as to retain its *hardness* all the *Summer* over, so as that it will scarcely melt when laid near the *Fire*.

The Reason hereof is, because the *pores* of Ice are so narrow, that it can admit nothing, save only the *particles* of the most *subtil matter*, and consequently by excluding all greater *particles*, hinders the *Heat* from entering to the *Inward parts*, save only as the melting of the *Outward parts* make way for it.

XXIII.
Whence
cold Bodies
have the
power of
changing
Water into
Ice.

Cold Bodies, such as the *Air*, often change the *water* they touch into *Ice*.

The Reason is, because *cold Bodies*, by their Touch, do not only lessen the *motion* of the insensible parts of the *water*; but also forasmuch as they contain many *Icy particles*, that is, *smooth* and *stiff*, they make the greater *Globuli* to pass out of the *water* into the *pores* of the *cold Bodies*; and on the other hand, cause the little *Globuli* to pass out of the *cold Bodies* into the *water*. And forasmuch as these little *Globuli*, because of their remiss degree of *motion* cannot preserve the *water* in its fluidity, their *motion* by this means ceaseth, and by this *Rest* of their *parts* are changed into *Ice*.

XXIV.
Fruits and
Stones too,
are spoiled
by Cold.

Extream *Cold* is of that *Malignity*, that it is the Cause of the *Corruption* of *Bodies*, changing their *Colour*, and spoiling all their *Comeliness* and *Beauty*. This we see not only in *Eggs* and *Fruits*, but also in *Wood* and *Stone*, which with *Frost* are sometimes made so brittle, as to be unfit to be used in the *Building* of *Houses*.

Frost causeth this *Putrefaction* in *Bodies*, by dilating the *watry parts* wherewith the *pores* of *Bodies* are fill'd; because by this dilatation the *fibres* and other solid parts, are broken or distorted. For nothing else can be understood by *Corruption*, but the *Transposition* of *parts*, when those which were joyned, are separated, and enter upon new *Combinations*. Hence it hath been observ'd, that when the *Eyes* of *Animals* have been *frozen*, the *CrySTALLINE Humour* hath become of a *white Colour*, whereas it was transparent before.

And from the same cause it is, that *Men* in *Russia*, and other *cold Countries*, do lose their *Nose*, *Ears*, and othe parts of their *Body*, by the Rigour of the *Cold*, which mortifies and putrifies the parts, as before hath been said.

XXV.
Cold some-
times per-
verts the
order of
Parts.

Such is the *Power* of *Cold*, that it sometimes perverts the *Order* and *Texture* of the parts of *Bodies*. For to what else can we impute, that great *Beams* of *Timber* in very *Cold Countries*, are to that degree *frozen*, that except they be thawed with a moderate *Heat*, they slit to pieces, and are altogether useless for *Building*? Whence is it that *Marle*, laid upon the *Ground* to dung it, does never obtain its end more, than when it is *frozen* by extream *Cold*? For the *Moisture* that

was contained in its *pores* being by this means dilated, the *Texture* of its *parts* becomes dissolved; so that whenever a good *Shower* falls, they are the more easily dissolved and mingled with the *Earth*.

And on the other hand, *Cold* preserves some *Bodies* from *Putrefaction*; whereof the *Swallows* are an incontestable Proof, which being stiff with *Cold*, and in appearance no other than *dead*, are kept all the *Winter* over in many of the *Pools* of *Poland*, without the least taint of *Corruption*.

XXVI.
The Cold
preserves
some Bo-
dies from
Putrefac-
tion.

The Reason of this is, because *Cold*, whose Nature consists in *Rest*, doth restrain the *motions* of the *parts*, and consequently hinders their separation from each other: For the dissolution of *parts* is the ready inlet of *Corruption*, forasmuch as thereby the whole *Texture* of the *Body* is disorder'd.

In like manner we find, that all manner of *Meats* and *Drinks*, are better preserved in *Winter*, than in *Summer*; and that *Flowers* and *Fruits* are kept for a long time untainted in *Snow* and *Ice-Houses*. Hence it is also, that *Dead Bodies* cover'd in the *Snow*, continue a long time without putrefying. In *Iseland* they customarily expose their *Fish* and *Flesh* to the *Air*, and when they are thoroughly hard and dry, preserve them untainted a great while without any *Salt* at all added to them; because the *Cold* keeps their parts at *Rest*, and suffers them not to be separated from each other.

CHAP. IV.

Of Heaviness and Lightness.

IF two *Bodies* of a round *Figure*, the one of *Lead*, the other of *Wood*, of the same or different bigness, should be let fall from the same *Horizontal Line* at the same moment of time, they will both of them come to the *Ground* at the same time; neither will any diversity be perceivable in their *Descent*, which GASSENDUS saith he hath frequently observed.

Two Bodies
of unequal
Bulk are
moved
with an
equal mo-
tion, if
they be
Spherical.

No other Cause of this uniform *motion* can be assigned, but the equal propension of the *Celestial matter*, to withdraw it self from the *Center* of the *Earth*. For tho' the said *Matter* doth always, in an equal space of time, and with all its force recede from the *Center*; yet doth it not wholly exert its *Power* upon the *Bodies* it meets with, but only that part of it which answers, and is equal to the *Body* it lights on. And forasmuch as there is great difference in *Bodies*, in respect of their *Composition*: Some of them are more solid than others, having less *pores*, which can only admit the most *subtil particles* of the *Matter* of the first *Element*, and very few only of the *Globuli* of the second; such as are *Gold*, *Quicksilver*, *Steel*. And others are more loose, or less solid, as *Wood*, and the like, which because they have more lax and open *pores*, do contain more *Celestial matter*, and therefore do more readily comply with the *motion* of the *Heavenly Globuli*.

But to Apply this to the matter in hand: If the *Celestial Matter*, which is in the *Leaden* and *Wooden Body*, should be taken away from them, and

and that the *Terrestrial Matter*, which is mixed with the *Heavenly Globuli*, should likewise be removed from them, that which remains of the *Celestial Matter* in every subordinate *Body*, and exerts its force upon the same, acts upon the remaining part of the *Terrestrial Matter*. For the *Leaden Body* being more solid, and consequently more able to resist, stands in need of a greater force of the *Celestial Matter* to press it downwards; whereas that which is less solid, will be carried down with a less force, and consequently they will both of them come down to the *Earth* with an equal swiftness. For to the equality of motion nothing else is required, but that the *Celestial Matter* be proportionate to the *Terrestrial*; which latter, when it is greater, the greater activity is required to overcome its *Resistance*; and when it is less, a less force of the *Celestial Matter* will serve to push the *Body* downwards.

Wherefore if a *Body* that is more heavy than the *water*, be put into it, it presently sinks to the bottom; but if it be lighter, according to the different degrees of the said *Lightness*, either it swims on the top of the *water*, or only some part of it sinks into it. Thus an *Earthen Vessel*, filled with *Air* swims upon the *water*; because it is lighter than it, being compared with a like proportion of it. Whereas the same *Vessel*, filled with *water*, sinks to the bottom, because compared with a like proportion of *water*, it is heavier than it. Hence it is that when a *Cup*, with the *Mouth* downwards, is put into the *water*, it doth not go to the bottom, because the *Air* contained in it is the same as if it were one *Body* with it, which being lighter than the *water*, must needs swim on the top of it, without sinking, till the *water* have entered the hollow of it.

But this seems to contradict another Experiment, whereby we find that the *Grains of Gold* and *Silver*, tho' they be more heavy than so much of *Aqua-fortis* or *Regalis*, yet do not sink in it. But this is to be ascribed to the *Saline Bodies* which are diffused through the said *waters*, and which, as it were by a continual chain from the bottom to the top, do support each other, and so bear up the *Grains of Gold* or *Silver*. That this is so, may be confirmed in that, when common *water* is poured to them, after the dropping in of some drops of *Oyl of Tartar*, immediately the *Grains* of the *Metal* sink down to the bottom.

Liquors that have communication by *Pipes* that contain them, do gravitate upon each other, not according to their *Breadth*, but according to their perpendicular *Height*.

The Reason is, because these *Liquors* are like so many hard *Bodies*, put into the 2 Scales of a *Balance*, whereof the one cannot go down, without causing the other to rise proportionably: For as these hard *Bodies*, tho' of unequal bulk, are nevertheless of equal weight, when their force is equivalent thereto, so likewise the *Liquors* contained in *Pipes* that communicate with one another, tho' they be of unequal breadth, yet must needs be of equal poise, when they are of an equal height. As for Example, in a *Vessel of Liquor*, clos'd on all sides except only 2 holes, if one of them be fourfold bigger than the other, and a *spout* adapted to each of them, the force of one pound of *Liquor*, forcing the little *Spout*, will

equal the force of 4 pound weight, forcing the greater, which is supposed 4 times larger than the other, so that whatever proportion there may be between the holes, if the force applied to the said *Spout*, or *Pipes* be equal to the holes, the *Liquors* will be in equal poise.

When we say that *Liquors* that Communicate together are in equal poise, when their heights are equal, this is to be understood only, when the 2 *Pipes* are filled with the same *liquor*: For if the *Liquors* be different, their height will be in the same proportion as their weight: So that because *QUICKSILVER* is almost 14 times more heavy than *water*, one thumbs breadth of *Quick-silver*, will weigh very near as much as 14 thumbs breadths of *water*.

A *Stone* or *Ball* falling down from the Top of the *Mast* of a *Ship* in its full course, or tost up by one that rides on *Horseback*, falls down at the foot of the *Mast*, and on the hand of the *Rider*.

The Reason is, because the *Ball* in its descent or ascent doth not describe a *Right*, but an *Oblique Line*. For though it seem to them who are in the *Ship* to be Perpendicular, yet is it indeed *Crooked* or *Parabolical*. Which any one that pleaseth may experience by casting up a *Ball*, or other thing into the *Air*, whilst he is riding in a *Coach*, for he shall find that the same, notwithstanding the progressive motion of the *Coach*, will fall directly into his hand; but if he shall command the *Coach* to stop immediately, he will see that the *Ball* doth not tend directly upwards, nor fall down perpendicularly, but obliquely, and so describes, as it were an *Arch*, or *crooked Line*, the one end whereof will be there where he casts up the *Stone* or *Ball*, and the other end, where he catches the same again. But the Reason why the *Ball* appears to him, to tend directly upwards, is because that as much as he moves forward, so much the *Ball* is advanced also. Now the Cause why the *Ball* deviates from a straight motion to a crooked is, because its motion is derived from a twofold moving force, viz. from that of the *Arm* casting it upwards, and from that of the *Coach* or *Earth* impressed upon the *Arm* Horizontally.

All *Bodies* that are not of a *Round Figure*, are carried downwards by an unequal motion, as is evident in all *Square*, and other *Corner'd Bodies*, which tho' they consist of the same matter, and are of the same Bulk, yet differ in their motion, and unequally move downwards.

This difference of motion is caused by their *Figure*; which tho' it cannot be said to be the cause of their being prest downwards, yet doth much conduce to the diversity of their motion. For things that are *Rough*, do more slowly fall through the *Water* or *Air*; and the broader their surface is, the greater resistance do they make against the *Body* through which they pass; because they do not divide it uniformly and steddily. Thus *Water* and *Ice*, are kept hanging in the *Air*; and greater *Flocks* of *Snow* congealed by cold, are more slow in their descent than drops of *water*. And it is for the same reason that *Birds*, with their spread *Wings*, keep themselves pois'd in the *Air*, viz. because the *Air* opposeth a greater resistance to a spread or plain extension, and hinders its falling down.

V.
When *Liquors* are said to be of equal poise.

VI.
Why a *Ball* falling down from the top of the *Mast* into a *Ship* under *Sail*, yet falls down plumb at the foot of the *Mast*.

VII.
Square Bodies do unequally descend to the *Earth*.

ssss

Drowned

II.
Why no *Body*, except it be more heavy than *water*, doth sink in the *water*.

III.
Why *Gold* doth not sink in *Aqua-fortis*.

IV.
Liquors that have communication together, are more or less heavy, according to the degrees of their height.

VIII.
Why the
Bodies of
some per-
sons drown-
ed, do after
some time,
rise up to
the top of
the water.

Drowned Bodies do after some space of time rise from the bottom, and swim at the top of the water.

This Effect is commonly attributed to the breaking of the *Gall*, but this I look upon only as a *Fable*. Wherefore I suppose that the true Reason why *drowned Bodies* rise to the top of the water is, because that the water entering into their *Bodies*, doth extend the *Membrans* thereof; by the expansion whereof, many other Cavities also are opened, which by taking in the *Air*, are distended to a greater space: for such *Membrans* as these, because of the connexion of their parts, do reject the water, and can only be filled with *Air*. By which means the *Bodies* having got greater extension, and made more light are driven upwards, and so swim on the top of the water.

IX.
New laid
Eggs are
heavier
than stale
ones.

In like manner it is the entering of *Air*, that makes *Eggs* to be lighter when they are *stale*, than when they are *new laid*; for when they are *newly laid* they are top-full with their own substance, without any *air*; but when they grow *stale*, some particles of the *White* and *Yolk* do exhale, and leave an empty space, into which the subtil *Air* enters, and it may be the more gross also, through the pores of the *Shell*; so as that it must not seem strange to us, if they do not sink in the water as deep as they did when *newly laid*.

X.
Why the
dead Bo-
dies of Men
swim with
their Faces
upwards,
and those
of Women
with their
Faces down-
wards.

Accordingly also, the reason is evident why *Female Bodies* swim on the water with their *Faces* downwards, but those of *Men* with their *Faces* upwards. For *Women* having greater *Bellies*, and more *Cavities* in them, besides their *Breasts*, which are of a *Spongy Substance*, do take in more water in those parts, and therefore by the weight thereof are turned with their *Body* downwards: Whereas *Men* have more narrow *Bellies*, lesser *Breasts*, and strait *Urinary Passages*, with large *Lungs* and broad *Shoulder-blades*, which are the cause why their *Bodies* should swim with their *Faces* upwards.

XI.
How Men
may best
hinder
themselves
from
drowning.

Wherefore *Men*, if whilst they are swimming, they find themselves in danger of being *drowned*, they can do no better for the avoiding of that danger, than to extend their *Chest*, and hold their *Breath*. And therefore *Fishes*, that they may swim with the more ease, have *Bladders* blown up with *Air* in their *Bellies*. And in like manner *Bees*, that they may the more lightly hover in the *Air*, have the *Trunk* of their *Body* fill'd with *Air*.

XII.
Burnt
Bricks are
heavier,
than they
were before
they were
burnt.

It is found by Experience, that *burnt Bricks* are heavier than unburnt.

The Reason whereof is, because the pores of unburnt *Bricks* are wider, and filled with *Air* only after that they are dried: Whereas *Bricks* after that they are burnt, have many *Cavities*, of such a bigness as is fit to admit the particles of water that run into them, when they are exposed to the *Air* to be cooled. For there is always great store of these particles in the *Air*, and which intruding themselves into the pores of the *Bricks*, do encrease their heaviness. A confirmation whereof may be, that if the same *Brick* be weighed as soon as it comes hot out of the *Brick-kiln*, it will be found more light, than after it hath been for some time exposed to the *Air*; and if afterwards it be put into the water, it will still be found more

heavy, because the particles of the water which are entred into its pores, cannot get out.

If a *Stick* be plunged into the water perpendicularly, it riseth up again with the greater force, as the water is higher.

The Reason of this is to be fetched from the nature of *Gravity*: For seeing that the *Stick* cannot move upwards, but only in as much as it is driven up by the water, it must follow that the greater the force of the expelling *Body* is, so much the more strongly the *Stick* must rise out of the water: Now this force is by so much encreased, by how much the weight of the expelling water is greater, by the force whereof it drives up the *Stick*; and therefore it follows, that the higher the water is, with so much the greater force is the *Stick* driven upwards, and so much the swifter it ascends.

The motion of *Heavy Bodys* is encreased according to uneven numbers: As if suppose a *Stone* fall down one *Ell* in the first moment of time, in the second it will fall 3, in the third 5, and in the fourth 7, and so on according to the following uneven numbers.

The Reason whereof seems to be, because the heavy *Body*, in the first moment of time hath by little and little acquired one degree of swiftness. Wherefore at the beginning of the second Time, having that degree of swiftness which it acquired, it will pass through as much space again, as it did in the first moment; and moreover by little and little acquiring force by its weight, by means whereof it passeth also through an equal space to that which it measured during the first moment; it must needs follow, that being now moved by both these forces together, it will pass through a triple space to that it past at first. At the third moment of time likewise it hath two degrees of swiftness, whereby it measures four times as much space as the first was. And in the mean time also by this innate *Gravity*, whereby it is continually pressed, doth acquire another degree, whereby in like manner it measures the space of another *Ell*. Being therefore thus furnished with three degrees of swiftness, it passeth through 5 times as much space, as it past at the beginning; and so afterwards continues to make its progress by uneven numbers, because the acquired degrees of swiftness always continue the same, as well as its natural heaviness.

The Times being 1, 2, 3, 4, 5, 6, 7, 8.
The Intervals or Spaces are 1, 3, 5, 7, 9, 11, 13, 15.

It is the common received opinion, that the *Bodies of Animals*, after death, are more heavy than when alive.

The Cause of this change is commonly attributed to the want of *Vital* and *Animal Spirits*; which being supposed, not only to be active, but also very light, do seem to diminish their *Gravity*. And forasmuch as *Flame* is lookt upon as the most light of all *Bodies*, no wonder if some have ascribed the Lightness of *Living Bodies* to that *Flame*, which being diffused through the whole *Body* of the *Animal*, doth vivify it, and is therefore called *Vital*. But however, notwithstanding, this Reason seems probable, yet I would have us rather trust to Experiment, than to this Reason. For Mr. BOYLE, for a trial, weighed a *Mouse* alive with a *Packbread* tied about its Neck, where-

XIII.
A Stick
thrust into
the water,
rises up
with so
much the
stronger
force, as
the water
is higher.

XIV.
Bodies dif-
fer by un-
equal num-
bers.

XV.
Whether
Dead Bo-
dies be
more heavy
than Li-
ving.

wherewith it was strangled immediately after, and when dead, was found to have lost of its former weight $\frac{1}{2}$ of a grain. And the same thing was experimented by him in a *Whelp*, which alive weighed 10 or 11 ounces, and being strangled, was found 4 grains lighter. Which Experiments absolutely contradict the common opinion, that *Dead Bodies are more heavy than living*, and that by the loss of *Spirits* they acquire a new degree of *Gravity*.

XVI.
An Arrow
mounts and
falls with
the like
swiftness.

An Arrow shot into the Air upwards, descends from its point of Elevation with the like swiftness, as it was shot up thither by the Hand of the Archer, tho' not in the same manner.

The Reason is, because an Arrow, in the beginning of its ascent, is not carried with more swiftness, than towards the end of its descent: Nor on the contrary more slowly towards the beginning of its Descent, than at the end of its Ascent, and therefore it is necessary that the Descent of the Arrow should be as swift as its Ascent.

XVII.
Square
Pieces of
different
matter, be-
ing laid
upon one
another,
descend
equally.

A square piece of Wood, and another of Lead being let fall severally, make an unequal descent, but if the Wooden Square be laid upon the Leaden, they will both descend with equal swiftness.

The Reason why a Square Piece of Wood, and another of Lead do descend unequally is, because besides the force of the subtil matter driving downwards, there is a greater force in the square piece of Lead to resist the Air, than there is the Wooden Square. For if the square piece of LEAD be of 16 pound weight, and the Wooden Piece of 1 Pound, and the resistance of the Air as two, so far as both the Cubes are supposed to be of the same magnitude, the Proportion of the Lead, must have the same proportion to the resistance of the medium, as 16 to 2, and of the Wooden Cube, as 1 to 2. And therefore it is necessary that the Leaden Cube should fall down more swiftly: but when the Wooden Cube is laid upon the Leaden, so as that no Air comes between them; the Gravitation of them both must needs be equal, since they have both the same Resistance, and the medium makes way for them both at once.

XVIII.
Why water
mounts up-
wards
through
the Leak of
a Ship.

Water, like to Light Bodies, mounts upwards through the Leaky Bottom of a Ship.

For seeing that Water is heavy, and presseth upon the Body it lies upon, it cannot be but that the water which flows about the bottom of the Vessel, must be thrust away by the water that lies above it. For the parts of water which are above, press downwards by their weight or heaviness, and force that which is under them, to enter through the Leak into the Ship; so that if there was a Pipe fitted to the said holes, there is no question but the water would rise up through the same, as it doth in Fountains.

XIX.
Whence the
different
heaviness
of Bodies
doth pro-
ceed.

Bodies are very different from one another in weight; as Quicksilver is much more heavy than water; neither are there any metals but differ from each other in this Quality. Thus Gold, if we will believe GASSENDUS, is 10 times heavier than Earth; Lead, 7 times; Silver, 5 times; Pewter or Tin, 4 times; Loadstone, 3 times, Whetstone as heavy again, &c.

And so far as it is frequently of great use, to know the weight or heaviness of several Bodies, I shall here subjoin a Table, exhibiting the just weight of different Bodies, according to the Pa-

ris weight that every Square Foot of them weighs.

A Cubical Foot of	Pounds
Water	72
Wine	70 $\frac{1}{2}$
Oyl	66
Tin	532 $\frac{1}{2}$
Iron	575
Copper	648
Silver	744
Lead	828
Quicksilver	977 $\frac{1}{2}$
Gold	1368
Earth	95 $\frac{1}{2}$
Bricks	130
Sand	132
Stone	140
Marble	252
Irish-slate	156
Salt	117 $\frac{1}{2}$
Honey	104 $\frac{1}{2}$
Wax	68 $\frac{1}{2}$
Air	$\frac{1}{3}$ of an ounce.

All which different degrees of Ponderosity of Bodies proceed from the various Make and Texture of their parts, whether inward or outward. For it cannot be questioned but that there be many Pores between the Particles of all Bodies, through which the subtil matter passeth continually from the abundance or fewness whereof the diversity of Bodies doth arise. Hence it is that Quicksilver is found to be so much heavier than Water, because it hath fewer of these Pores. For tho' we may imagin, that Water and Quicksilver consist of parts that are of the same bigness, and that their motions are alike, yet will their diversity clearly appear to us, if we consider the particles of Water to be like a soft and slack String, and the parts of Quicksilver, as having fewer Pores, to be like hard twisted Strings, that are much more stiff and hard. And the same is to be understood of those metals which are several times heavier than the Earth, since that all difference proceeds from the multitude or paucity of their Pores that admit the subtil matter, and do variously dilate and contract themselves in compliance with its motions.

Lead sinks more slowly in the Water, than in the Air; and a Log of Wood which is very burthenfom to the party that carries it, rests on the surface of the water, and scarcely seems to be of any weight at all.

A twofold weight may be understood to be in Bodies, the one Absolute, and which is not subject to any alteration, as being indistinguisht from the Body, and cannot be encreased, but by the addition of parts to it. Thus Gold is heavier than Lead, because its parts lie more snug and close together, and have straiter pores. The other weight of Bodies may be called Relative, which varies according to the different position of the matter; and according to this notion of Gravity, Lead is said to be less heavy in the Water than in the Air; because the water doth more strongly resist it, and by that means detracts much from its weight. Thus Wood swims upon the top of the Water, and doth not sink till it putrifie and corrupt,

XX.
Lead seems
more heavy
while it
passeth
through one
Body, than
through
another.

be-

because the *water* is heavier than *wood*, and drives it up to the *surface*. For the *parts* of *water*, in the same bulk, are more than twice as many as the *part* of *wood*; and according to the *Laws* of *Nature*, *Things* that exceed in number, cannot be driven forwards by those that are fewer. Thus it hath been observed, that a *Young man* that weighed 130 pounds, did not weigh in the *water* above 8 Ounces.

XXI.
How we may know the different weight of Bodies.

And on the contrary, if a *heavy Body*, as for Example *Copper* do much exceed *water* in ponderosity (for it is accounted to be 9 times heavier than *water*) it will lose a 9th part of its *Gravity*. So that if *Copper* should be hung up by a string first in the *Air*, and afterwards in the *Water*, then the 9th part of the weight is to be removed out of that *Scale* which hangs in the *Air*, that there may be an Equality. And by this means we shall easily perceive the true weight of every *Body*, and how much more heavier it is than the *water*.

XXII.
The different Heaviness of Bodies in the Air, and in the Water.

So in like manner it happens that those things, which when weighed in the *Air*, are in equal poise, do lose the said Equality when put into the *water*, by Example *Copper* and *Lead*: For *Lead* put into the *water*, takes up a less space than *Copper* of the same weight; and therefore when both these *Bodies* are weighed in the *water*, the *Lead* must of necessity out-weigh the *Copper*, with which it was in equal poise in the *Air*. And by this means it will not be difficult, to know what *Metals*, according to their bulk, are heavier than others. For if when they are weighed in the *Air*, neither of them exceed the other in weight, and that when put into the *water*, they are not in the same equal poise, that which out-weighs the other, according to its bulk, must be supposed heavier.

XXIII.
Respective Gravity may be changed; but absolute cannot.

Whence it follows, that the *respective Gravity* of a *Body* may be changed, whilst the *absolute* still continues the same: As suppose we put into one of the *Scales* of a *Balance* 100 Pounds, and in the other 50, then the absolute Heaviness of the first weight will be always of 100 Pounds; but the *respective Heaviness* will be only of 50 Pounds; nay, it will be no more than 20 or 30 Pounds, if we put in the other *Scale* a *Body* of 80 or 90 Pounds. And for the same Reason, if we hang the weight of 100 Pounds at the end of a *Standard*, tho' the said absolute weight continue, yet may the *respective* be changed every moment; according as the weighing *Body* is nearer or farther from the fixed Point, than that weight is, which is at the other end of the *Standard*.

XXIV.
Heavy Bodies increase their motion in falling.

Heavy Bodies do not move equally in their Descent, but accelerate their motion; as is evident in *Stones*, which according to the greater distance from whence they fall, make the stronger impression upon the things they light on.

The Reason is, because a *Body*, at the beginning of its motion, moves but little; for the *subtil matter*, which takes up its place, and which alone acts upon it, does not drive it downwards with that swiftness wherewith it endeavours to withdraw from the *Center*: But when the *Body* begins to descend, the *subtil matter* which is under the *Body*, and which with great endeavour strives to get above it, doth continually drive it downwards, and adds new degrees of Swiftness to those it had before.

Or else we may say, that the motion of *Heavy* things is accelerated; for that *Bodies* in their descent do acquire a new Force. For tho' they pass but slowly at the first moment of their motion; yet at the second they must move more swiftly, because they retain their former motion, and receive an augmentation of it from the Action of the most subtil Matter.

Thus when a *Bullet* or *Pellet* is by the blast of our *breath* driven through a *Pipe*, the *Breath* that proceeds from our *Lungs*, doth with repeated Onsets strike against it, whereby the first impulse impress'd upon it is increased, and new degrees of Swiftness added thereto, whereby it becomes more vehement than it was at first.

Hence it is also, that the *water* which by Example is fallen down 3 Foot and an half, hath its Force once and half as much increased, more than that *water* which hath made a descent of one Foot only; and that consequently the *water* which gusheth out of a *Pipe* fill'd to the height of 3 Foot and an half, must run twice and an half faster, than when it runs from a *Pipe* that is only full to the height of one Foot; for that by that time it is come to the end of the *Pipe*, it will have acquir'd in its descent twice and an half more Swiftness, than it would have got, if it had only made a descent to the 4th part of the *Pipe*.

Nevertheless, we must not imagine that the motion of *Heavy Bodies* doth increase continually, so as to have no bounds of its augmentation: For the *Air* resists the motion of *Bodies*, and blunts their force. Hence it is that a *Bullet* discharged from a *Canon* at a great distance, doth less hurt, than if it were shot nearer. And so likewise we see in the *Pneumatick Engine*, that when all the *Air* is pump't out of it, *heavy Bodies* do fall with a great force at the first, and do exert the entire force of their *Gravity*: Like as *Bodies* cast up into the *Air*, in the beginning of their motion, do exert the whole Swiftness they have received.

A *Pail* full of *Water*, in a *Well* or *Pool*, loseth all its *Gravity*; seeing that with the least force it may be removed, this way or that way, upwards or downwards, without almost any perception of ponderosity.

The Reason is, because the *parts* of *water*, whilst they are mingled and hang together, do do not press one another; for being all of them equally solid, they are all equally prest towards the *Center* by the *Celestial matter*; and therefore the *Pail*, because of their equal pressure, is with the least force moved any way. In like manner a man that is sunk under *water*, is not sensible of any ponderosity; because the *Waters* which lie upon him, are less prest by the *Heavenly Globuli* that run between them, than the *man* himself, who is a more solid *Body*, and consequently less pervious to the subtil matter.

Which is the Reason why *Divers* cannot come to the bottom of the *Sea*, without *Weights* hung upon them; because they are equally prest by the *water* that surrounds them, and as much born up by that which is beneath them, as they are thrust down by that which is above them. So that if a *Diver* being at the bottom of the *water*, could apply and fasten to his *Arm* or *Thigh*, the lower part of a long *Pipe*, the other end thereof

XXV.
A Bullet driven through a Pipe or Bore, moves unequally.

XXVI.
Why Water falls down unequally through Pipes.

XXVII.
The acceleration of motion is performed by the acquiring of a new degree thereof.

XXVIII.
Why a Pail is not heavy in the water.

standing out above the *water*; so that the *water* could not come in between them, that part of his *Body* would presently begin to swell, it being free from the pressure of the *water*, and the *Blood* would run thither from the other parts of the *Body*.

Hence it is also that a *Body* is more born up by *Running-water*. For the force of swiftly *Running-water*, doth make the ponderosity of the *Body* almost insignificant; as we see in things that are thrown or cast upwards. Wherefore we find, that a *Body* doth more easily swim on the top of *Running-water*; because there are many more parts of the *water* that resist its sinking, since continually other new parts succeed to support and keep it up. And this is the foundation of the *Art* of *Swimming*.

CHAP. V.

Of Taste.

Hard Bodies, such as *Stone*, *Iron*, *Lime*, *Harts-horn*, &c. are insipid, and do not at all affect the *Tongue*.

Because the particles of *Hard Bodies* cannot be separated from each other, and consequently be mingled with the *Spittle* in our *Mouths*. For when *Bodies* are so compact that they cannot dissolve and furnish those particles, which by the Vehicle of *Moisture*, may be conveyed into the pores of our *Tongue*, no wonder if they be insipid. For tho' *Sugar*, when melted, affords a *sweet taste*; yet when the same is brought into solid and compact pieces, it affords no taste at all, because its parts cannot readily be separated, to impress any taste upon the *Organ*. So for the same Reason *Pills*, when they are swallowed whole, are scarcely perceived, because they do not stay long enough to have their outward parts dissolved, without which they cannot affect the *Organ* of *Taste*.

Thus *Turpentine* boiled, and made into *Powder*, is lookt upon to be insipid; because the more subtil parts of it cannot be diffused or mingled with the *Spittle*: Whereas in its *Liquid* form, it exhibits a *bitter taste*. So that Experience teacheth us, that nothing else is wanting in these *Bodies*, to make them *Savoury*, but only the division of their parts; seeing that the *Salts* which enter the Composition of *Glass*, were *savoury* before they were compacted into that hard consistence, and that *Metals* reduc'd into very small powder, tho' before they were insipid, do now yield a most strong and intolerable taste.

Almost all *Bodies* are distinguishable by their tastes; as *Honey* is sweet, *Wormwood* bitter, &c.

The general Cause of all *Tastes* and *Savours* depends on the greatness and figures of the parts of *savoury Bodies*, which are capable of being diversified after an infinite manner of ways: And forasmuch as *Bodies* are in a manner all of them composed of parts that are of a different bigness and figure, it must not seem strange to us, that we meet with so great a variety of *Tastes*.

This difference of *Tastes*, is sometimes caused by the various agitation of the parts of *Bodies*; for we experience that *hot Meat* is more *savoury* than *cold*, because *heat* increaseth the motion of

the parts of the *Body*; and besides, it is certain, that the more any *Body* is moved, the more fit it is to move another *Body* that toucheth it: And therefore it cannot seem strange, that *Meats*, when hot, are a great deal more *savoury* to us, than when they are cold. This is the Reason also why *dressed Meats* are far more *savoury* than raw, because the heat of the fire that dresseth them, divides them into lesser parts, whereby their figures are changed, and so make them to be of a very different Taste from what they were, when Raw.

Sweet things do sooner fill than sharp. Thus we find that *Milk-meats*, *Sweet-meats*, *Butter*, *Honey*, &c. do sooner satisfy our *Appetite*, than *sowre* and sharp things.

Some suppose the Cause hereof to be, because *Sharp things* do afford little *Nourishment*, and much *Excrement*; but this Reason seems of no force, because *Digestion* does not immediately follow upon the taking down of our food: But the Cause why *Sweet things* do sooner glut the *Appetite*, than sharp and *sowre* things is, because these latter are made up of parts whose surface is very rough and rugged, that is, which have many Angles or Inequalities, which make them fit to twitch and vellicate the *Bodies* they touch or apply to; and by this their vellicating of the *Stomach*, do stir up the *Appetite*: Whereas *Sweet things* consisting of smooth *Bodies*, and such as gently affect the *Stomach*, without exciting of the *Appetite*, do presently fill and satiate.

Fire procures a sharp Taste to *Meat*; for we find that *Roast-meat* doth with more sharpness strike the *Tongue*, and affords a more grateful taste.

For it is evident that there is no food, but contains some *Salt*, which is in a manner equally diffused throughout the whole Mass of it. Whence it is, that when *Meat* is agitated by the heat of fire, some part of this *Salt* is carried to the outside, and exhales with the other *Liquid* parts, and constitutes that *Smoke* which we see proceeds from *Meat* that is a *Roasting*. But whereas they are only the insipid particles that fly into the Air, those of the *Salts* can scarcely rise 2 or 3 fingers high; but that by their weight they are forced down again to the surface of the *Meat*, and there produce that sharp taste which we experience in *Roast-meat*.

Things barsh and sowre, set the Teeth on edge; as unripe Fruits, barsh Wines, Verjuice, and the like.

The Reason is, because the fixt Salts that are in these Bodies, being entangled in a gross Saltpur, compose together with it parts, whose Surface is bristled with many Hairs variously bent, which entring into the pores of the Tongue, shut up the parts thereof.

Bitter things, as Orange-Peel, Venice-Treacle, and many purging Medicines do heat; but Sowre things, such as Juice of Orange, Sowre Grapes, &c. do cool.

Because Bitter things consist of sharp Salts, and gross Oils, which being agitated together, do excite and preserve heat; whereas the parts of Sowre things are long, stiff and pointed, and rather stop the motion of the fiery particles, than promote it, and for that Reason are esteemed of a Cooling Nature.

T t t t

U n r i p e

XXIX.
A Body is more hindered in its descent, by Running-water.

I.
Hard Bodies, as Stone, Iron, and the like, are insipid.

II.
Why Bodies are distinguishable by Taste.

III.
Hot Meat is more savoury than cold Meat.

IV.
Sweet things do sooner cloy the Stomach, than Meat of a sharp taste.

V.
The Fire excites a sharp taste in Meat dress'd by it.

VI.
Sowre and Harsh things set the Teeth on edge.

VII.
Why Bitter things do heat, and Sowre, cool.

VIII.
Why un-
ripe Grapes
and Fruits
are harsh.

Unripe Fruits seem very harsh at the first taste, and cause a Roughness on the Tongue; but afterwards they turn sweet, and acquire a pleasant relish.

The Reason is, for that Fruits, before that they are ripe, do consist of longish parts, which by their motion do, as it were, cut the fibres of the Tongue, and contract them; and afterwards they grow ripe by means of the fire or the heat of the Sun, which digests their raw Juice, and by exhaling the Heterogeneous parts, reduceth it to sweetness. For it is evident, that there is a continual resolution and division of parts in Fruits that tend to maturity, by means whereof they lay aside their hardness and harshness, and after perfect Concoction become soft and pleasant.

IX.
A Tongue
that is
either too
dry, or too
moist, can
taste
nothing.

A Tongue that is parch'd and over-dry, hath little or no taste; and so likewise when it abounds with over-much moisture.

The Reason is, because Taste doth not only consist in moisture or driness apart, but in a mixture of them both. And therefore it is no wonder, if a too dry and parched Tongue, cannot perceive the taste of solid food, seeing that the same cannot be macerated or dissolved without moisture, which is necessary in order to the Sense of Tasting. For the Tongue being a spongy and porous part, stands in need of moisture, which is the vehicle of Savours. Moreover, in a dry Tongue the fibres are too much contracted, and thereby are made unfit to receive that affection, which the savour of things doth impress on it. And on the other hand, a Tongue too moist, is not fit for the reception of Tastes, forasmuch as the Tongue, which is loose and spongy, having its pores already filled with Humour, cannot well admit that which conveys the Savoury particles of the food, and by this means cannot perceive the taste of it. And it is for this very Reason, that we cannot relish Wine after having eaten some sweet thing, and that in order to recover our taste we eat salt meat, that may open the pores of our Tongue.

X.
Why we
find no
relish in
those things
which we
eat often.

Some find that they lose the relish of those things, which they feed too frequently upon, and that either because these common Aliments do leave some of their particles in the Tongue, which render the little Nipples of it immoveable; or, because the Soul gives less heed to those motions that are ordinary and common, than to those which are new and unfrequent.

XI.
Why we
can better
discern
Tastes in
the Morn-
ing.

Tastes are better discerned in the Morning, especially before we have eaten or drank any thing, that can byass the Tongue to a mistaken Verdict.

Because at that time the Tongue is like fair Paper, and as yet unting'd by any Savours. For that which receives, must be free from a Taint of the thing received. Which is true not only in the Taste, but also in Hearing, Smelling, and all the other Senses: For by right, the Sense of Hearing is sharpest, and Blind men do better retain things than others.

XII.
Persons sick
of the
Jaundise,
cannot
rightly
discern the
taste of
things.

Men sick of the Jaundise, suppose all things to taste bitter.

The Reason is, because the Gall is diffused through their Tongues, which infects their Spittle; for the Gall consisting of sharp particles, doth so corrupt the Spittle, that it communicates a bit-

terness and an ungrateful taste to all the Food that is eaten, as if something of Soot were mixt with it. The Cause of which Depravation is, because the Raw humour, which runs through the Veins and Arteries, betakes it self to the Tongue, because of its loose and spongy Flesh, and filling the pores of it, vitiate the taste of all received Aliments. Which is the Reason why Physicians commonly order their Patients to put out their Tongues, that they may view the colour and disposition of it; for seeing that that Member, proportionable to its bulk, contains abundance of Blood, it accordingly also admits a considerable deal of the morbid Matter, which there discovers it self by its Colour, and consequently also the Sickness which disturbs the Body.

The Juice of unripe Grapes constitutes that which is called Verjuice, which is of a sowre and somewhat harsh taste; whereas the Juice of ripe Grapes is sweet, and with a pleasant briskness accosts the Palat.

The harshness of Verjuice proceeds from the Roughness and Inequality of its parts; for because the Juice of unripe Grapes is not sufficiently concocted, they retain a great deal of Crudity, which is owing to their long and inflexible particles.

Hence it is that the Verjuice which is made of Crabs, is a good Medicine to help the weakness of the Eyes; because its particles being like so many little grains of Sand, do wipe off the filth of the Eyes, and by this means restore the Visive faculty to its former clearness. And the same Reason may be given of the Water of some particular Fountains, which by reason of their Acrimony do not only purge the Eyes, but also the Optick Nerves, that so the Rays of Light may be the more freely transmitted.

But New Wine is sweet, because it hath been sufficiently decocted by Heat, and all its parts are smooth and even. And as to its muddiness, that is only caused by those Heterogeneous parts, which are not yet separated from it; which as soon as they are either precipitated to the bottom, or raised up to the top, by fermentation, the Wine becomes clear, by admitting the Heavenly Globuli.

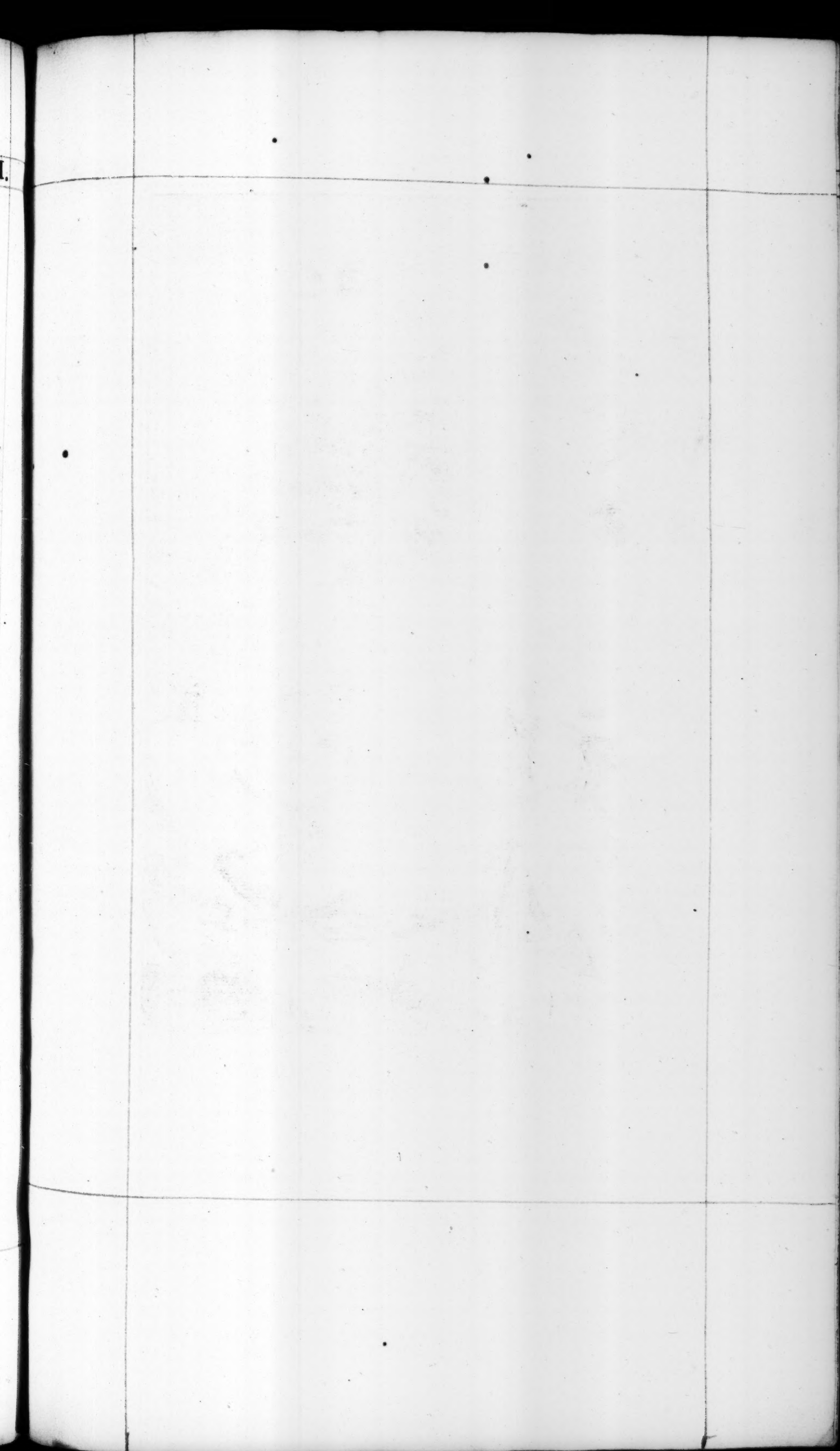
All Fruits are distinguishable by their taste, some of them having a harsh bitter taste, others a harsh sowre, other a sowre, and all of them a sweet taste after they attain to their full maturity.

This difference of Tastes in Fruits, proceeds from the various Texture of the particles, and the different structure of the Plants that bear them. For grafted Trees bear more delicate Fruits than others, because the Alimentary Juice is more exactly strained through the double twisting and weaving of their fibres. The Harsh-sowre taste therefore of Fruits proceeds from this, that their Parts are not yet sufficiently strained and digested; and because the surface of them, as was said, is bristled with many little Hairs, diversly bending this way and that way, which entering into the pores of the Tongue, do shut them up. As we find in the taste of Quinces, Medlars, and generally of all unripe Fruits. Other Fruits afford a smart or sharp taste to the Palat, because their particles are long, stiff, and very subtil; by which means they prick

XIII.
Whence the
Harsh taste
of Verjuice
doth pro-
ceed.

XIV.
Why New
Wine is
sweet.

XV.
What is
the Cause
of that
variety of
Tastes
which is
in Fruits.



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prick and divide the *Tongue*, and dilate the same with some kind of sense of *heat*. *Ripe Fruits* do generally afford a *sweet taste*, because the *Juice* of the *Plant* whence they proceed hath been well strained, and lost all its *Crudity* by the agitation of the *heat* of the *Sun*. Wherefore also such *Fruits* as these do pleasingly smooth and stroak the *Tongue*, and with a grateful softness enter the *pores* of it.

XVI. *Whythence it is that the same Food is not equally grateful to all.*

Nothing is of more obvious Experience, than that the same *food* is not alike grateful to all; and that frequently what is very pleasing to some, is very distasteful to others.

Which proceeds from the different disposition of the *Organ*. For they whose *Tongues* are furnished with stiff and less pliant *fibres*, will be less exact in discerning the *Taste* of things, because they stand in need of a greater Force to move them: Whereas those whose *fibres* are more delicate and tender, do more exactly distinguish them, because the least Vellication is sufficient to affect them. Somewhat like that which is found in the *hands* of those that are grown hard by much labour, which without any sense of Pain do handle *Briars* and *Thorns*, when those that have tender *Hands* cannot, without great pain, so much as touch them.

XVII. *Why the same thing seems sometimes to have a different Taste.*

Hence it is that sometimes the same person, upon some alteration in the *Organ* of his *Taste*, caused by Age or Sickness, finds a different *Taste* in the same Objects from what he formerly perceived in them: For the Texture of his *Organ* being changed, the *particles* of the *Bodies* do no longer accord with it, but cause a kind of rout and confusion in it. And it is for the same Reason that young *Women*, and such as are with *Child*, do sometimes take delight in some *Meats* which they formerly abhorred.

XVIII. *Why different men are pleased with different Sawces, and that there must be different Sawces to please the same person at different times and seasons.*

For one loves *sweet Sawces*, others *sour*; one man delights in the *taste* of *Wine*, another abhors it; and the same person that is greatly pleased with the *taste* of it, when he is in Health, doth loath it when he is sick of an *Ague* or *Fever*, because the *fibres* of his *Tongue* are otherwise disposed than they were before. This is visible in *Girls*, and *Women big with Child*, especially in the first Months after Impregnation, who frequently delight in, and long for those things which before they abhorred, or at least had no inclination to, forasmuch as the *particles* of those things enter more smoothly, into the *pores* of their *Tongues* than before.

XIX. *The Mistake of some Peripateticks.*

From what hath been said, we have reason to conclude, that it is a great Errour to place the *taste* or *savour* of things in the *savoury Objects*, as some *Peripateticks* do: For besides that in so doing they ascribe to an *Inanimate Body*, a way of Existence which doth not agree with them, the consequence of this Opinion is, that 2 Men would never be able to find a *different Taste* in the same Object, which is contrary to Experience. So that we must conclude, that the Power of perceiving *Tastes* belongs to the *Soul*, as well as that of feeling Pleasure or Pain; and consequently, that *Taste* is nothing else, but a certain *perception* or *sensation*, which is exerted by the *Soul*, by the

motions which Meats produce in the *Nerves* of the *Tongue*.

CHAP. VI.

Of Smelling.

SO great is the Affinity between *Taste* and *Smelling*, that they are produced and affect the *Organs* almost in the very same manner. For we find that *Animals* hunt out their Prey by their *Scent*, and by the same distinguish what is good, from what is hurtful to them. Thus the Smell of *Catmint* allures *Cats*; *Fennel*, *Serpents*; *Bazil*, *Scorpions*; *Rue*, *Weezels*, &c. As on the contrary, they avoid what is harmful to them by the help of the said *Organ*. Thus *Serpents* flee from the Scent of *Galbanum*, *Scorpions* abhor *Wolves-bane*; *Flies*, *Brimstone*; *Goats*, *Bazil*; and *Ants*, *Organy*.

The Cause of this *Sympathy*, or *Antipathy*, must be derived from the *Organ* of *Smelling*; which receives the diversity of *Odours*, according to the different affection and disposition of its *fibres*. For if the *Steam* that proceeds from an odoriferous Object, be delicate, and doth smoothly affect the *Nerves* of the *Nostrils*, it will cause a *grateful Odour*; but if the said *Nerves* be more rudely shaken or vellicated, this gives an unpleasing *Scent*. For *Odour* is nothing else, but the *thin* and *insensible* parts of *Bodies*, which being separate from each other, fly up and down in the *Air*, and being by the drawing-in of our *Breath* received into our *Nostrils*, do excite a motion in the *Extremities* of the *Nerves*. So that the diversity of *Motions*, produceth difference of *Odours*; and as the *fibres* of the *Organ* are more softly or roughly struck upon, accordingly are they diversified. For this Reason we find, that *Roses*, *Musk*, *Ambergris*, and such like, afford a sweet Smell; because the *Steam* that proceeds from them, consists of subtil and flexible *Filaments*, which easily enter the *Organ*, and without any roughness are communicated to the *Nerves*. But *Brimstone* affords a strong and unpleasant *Smell*, because of the Ruggedness and Unevenness of its *filaments*. For *Brimstone* being very easily inflammable, we must suppose it to consist of many fat *Steams*, which being mingled with a sharp Matter, do make the *filaments* rough and prickly, which cannot but affect the *fibres* of the *Organ* unpleasantly and painfully.

And on the contrary, when the strong Scent of *Brimstone*, is dulled by the joyning of some other *Body* with it, a grateful *Odour* is produced. Thus tho' *Civet* in a bulk, and by it self, have a very strong Scent; yet if 3 Grains be mixed with 10 Grains of *Ambergris*, and one Drop of the Juice of *Lemons*, and ground together, it will produce a most rich and grateful *Perfume*. In like manner, *Musk*, when it is by it self, yields a strong and overcoming *Scent*; but being mixt with some of the *Spirit* of *Roses*, it affords a most pleasing and delightful *Smell*. And they who bring *Musk* from the *Indies*, after that the Smell of it is in great part exhaled, do wrap it up in the *Skin* of the *Animal* from whence it is taken, or in *Bladders*, and hang it up for some days in some stinking place, having first made several Holes in the

I. *Animals, by their Sense of Smelling, discover what is good or hurtful to them.*

II. *How sweet Scents may be produced from strong and unpleasant things.*

the said *Skins* or *Bladders*; and by this means recover the *Musk* to its former fragrantcy. Forasmuch as by this Fermentation, its parts are so separated and attenuated, that they cannot but gratefully tickle the Organs of Smelling.

III. How some Bodies that have little or no scent, may be made odorous. And it is for the same Reason, that the *Oyl of Roses*, drawn by *distillation*, being put into *water* in a considerable Quantity, hath almost no odour at all, but being mingled with the *Salt of Tartar*, it makes a fluid composition, whereof some part being put into *water*, yields a very great and sweet perfume; the reason whereof is, to be ascribed to the *Salt of Tartar*, which being a very powerful *Alkali*, exalts the *Oyl*, and renders it more volatile, and consequently more proper to be attracted together with the *Air* in *Respiration*.

IV. To the perception of Odours, some distance is required. When a *Man* is too near to *odoriferous Bodies*, he cannot so well perceive their *Effluvia*. And therefore it is that *Flowers* do smell more sweetly when they are at some distance from the *Organ*, than when they are too near it.

The Cause is, because the *smell* or *odour* of *Objects* doth not consist in their more gross and moist, as before hath been said of *Taste*, but in their thin and dry parts; and therefore he who is too near to the *odorous Object*, doth not only take in the steams that proceed from it, but also those that come forth from the *Earth*. But if he be somewhat further at a distance from it, he receives nothing but the more vivid and subtil steams, because the Grosser cannot go far off, but soon fall down to the *Earth* again. Wherefore some distance is necessary, that the more brisk particles of the *odorous Object*, may freely and purely exert its power, and excite a grateful *smell*.

V. Perfumes are least perceived when too near. Hence it is that *Perfumes* cannot be so powerfully perceived when we are too near to them; for they consisting of nothing else but a steam, flowing from the *odoriferous Body*, by passing through some interval it becomes more purified and discharged from its more thick and terrene particles, which dull and allay the sweetness of the *odour*. As we find that *Wine* mixed with *Water* is less tasted, because *water* doth break and allay its force.

VI. Plants in Syria and Arabia do far excel ours in smell. Plants in hot Countries shed a far more fragrant odour than in cold. Thus it is known that in, *Syria*, *Arabia*, the *East-Indies*, &c. many *Spices* are produced, and that the *Fruits* of the *Trees* that grow there, have more lasting and pungent odours.

The Reason is, the *heat* of the *Sun* in those Countries, which conduceth very much to the briskness and sweetness of odours: For by means thereof the *Alimentary Juice* of *Plants* becomes exalted and depurated in the highest degree; and thereby prepared to yield copious matter for those *odoriferous steams* proceeding from the *Leaves*, *Fruits*, and *Flowers* of them. For it is certain that odours consist of *Sulphur* or *Salt*, and that those *Bodies* which abound with these, do shed more abundant odours. Because heat is a great strengthner and exalter of the *Sulphureous Parts*, causing them to exert their force with greater efficacy; for after that the *watry Humour* is separated, the remaining substance is more thoroughly concocted, and consequently yields a more fragrant odour. And therefore in order to the preserving

of this Fragrantcy, we make use of *Oyl* wherewith to cover them, or else shut them up in *Boxes*, to hinder the vapour from exhaling continually. For we find that all *odorous Bodies* do smell more strongly when they are *hot*, than when *cold*; in the *Day* time, than in the *Night*; in the *Spring*, than in *Winter*; and in *Summer*, than in the *Spring*, because then their parts are in greater motion.

For the same Reason it is, that *Fruits* attain a more grateful scent by being prepared with fire; and that all things smell sweeter during the *heat* of the *Summer*, than when they are congealed with *cold*; because then their *Sulphureous Parts* are lockt up: whereas in hot *Seasons* the same is agitated and diffused through the *Air*. And therefore we find that there are very few Seeds that afford any scent from them: for being of a very compact substance, and consisting of a clammy substance, they do not easily send forth any *Effluvia*. And on the contrary, we find that *Contusion* or *Bruising* is a great means to excite that sweetness of odour which is found in dry things. Thus the pricking of the Rinds of *Citrons* or *Oranges*, renders them much more odorous. And *Spanish Wax*, which is without odour before it be put to the *Fire*, becomes very odoriferous, by the resolution of some of its parts into *Smoak*. The same may be said of *Incense*, *Myrrh*, and many other *odoriferous Gums* and *Drugs*, which do not exert their fragrantcy till they be dissipated into *Air*.

VII. Heat conduces very much to the sweetness of Odours. All Men do not smell alike, for some yield a very fragrant and pleasing odour, which *Historians* relate concerning *Alexander the Great*, whose *Sweat* was very pleasing and grateful to all that smelt it. Whereas others stink, or scent very strongly; which is observed of *Flat-nos'd Persons*, who are commonly tainted with loathsome steams proceeding from them.

VIII. What is the Cause of that sweet or strong smell which proceeds from some persons. A Sweet Odour proceeds from those persons, whose *Alimentary Juice* is exactly and thoroughly concocted; which then happens, when by the agitation of the *Body*, the *Pores* are opened, to let out the particles of any crude *Humours*. The same may also be an effect of the *Temperament* of *Men*, as when *Heat* is greatly predominant in them; for if the said *Heat* be free, and is disentangled from any superfluous Humour, it cannot fail of producing a sweet odour. Now that such was the *Temperament* of *Alexander the Great*, is evident from his inclination to the excess of *Anger*, the continual exercise of his *Body*, and the smoothness and thinness of his *Skin*. But when on the contrary, the *Alimentary Juice* is not well digested, or by some means or other becomes depraved, this must needs produce an abominable and loathsome smell; such as we perceive commonly in *Flat-nos'd Persons*, whose steams are observed to be very nauseous; and that because the *Pores*, through which the *Snot* or *Snivel* is conveyed from the *Brain*, is too much straitened, and by reason thereof putrifies and corrupts there. For Corruption is the most genuine cause of *Stinks*.

IX. Of the various Virtue and Nature of Odours. And accordingly some smells are very refreshing, and conducing to *Health*, whereas other are very inimical to Nature, and our *Vital Spirits*. Thus we are told that there is a People in the most remote Borders of the *East Indies*, about the Springs of the River *Ganges*, called *Astomi* or *Mouth-*

Moutbleß, who (if we may give credit to some *Historians*) live only by the *odours* they take in from *Flowers* and *Fruits*. So likewise it is notorious, that there be many *Scents* which recall Persons that are in a *Swoond*; and more particularly the smell of *Vinegar*: And every body knows how much *Cats* are delighted with the Herb *Nepora*, or *Catmint*; which acceptableness and congruity proceeds only from the *odour* of these things. And on the contrary, some *smells* are the cause of *distraction*, as it is related of the *Sabæans*, that they used to be stupified by *odours*: And of *Cats*, that they became mad by the smell of some *Ointments*: because these exhalations cause so violent an agitation in the *Organ*, that thereby the natural Temperament of the *Brain* is destroyed, whence proceeds that tumultuary confusion of the *Spirits*.

Rose and *Orange-flower Water*, with other such like *Waters* distilled from *Flowers*, keep their sweet smell all the year, except only when the *Flowers*, from whence they are drawn, are most fragrant, for then they lose their Scent.

The Cause whereof is, not because those *Waters* are indeed destitute of all *Odour* at that time: but the *Earth* then abounding with *Flowers*, which diffuse their *steams* throughout the whole *Air*, the *Organ* of *Smelling* is so much charged with them, that it cannot be affected with the *smell* that proceeds from those *waters*; and upon this account they are supposed destitute of all *smell*.

Tinctures, *Essences*, &c. of *Roses*, *Cinamon*, and such like *odoriferous Bodies*, retain the same *smell*, which the things themselves had before.

The Reason is, because the nature of *Odour* consists in a certain texture of *Sulphur* and *Salt*. By *Sulphur*, the *Chymists* understand a Fat and *Oily Substance*, which according to its various mixture in various *Bodies* is different. Now since this *Substance* may by *Chymical Art* be extracted from *Bodies*, it must not be thought strange that it retains the same *Odour*, which the *Bodies* themselves before did.

They who have got a *Cold*, do in a manner perceive no *Odours* at all.

Because the *Rheum* doth so obstruct the *Pipes* of the *Olfactory Organ*, into which the *Odorous Steams* use to insinuate themselves, that they can no longer enter them. For in this case the obstruction sometimes is so great, that there is no passage left in the *Nostrils* to draw ones *Breath*; and therefore it is no wonder, if the *Nerves*, being filled with this humour, cannot admit the *Steams* proceeding from *odorons Objects*, or if they do, yet cannot receive any due impression from them.

In *Cold Weather*, *odorons Objects* do more weakly affect our *Organ* of *Smelling*.

This is, because in *Winter* time the *pores* are obstructed and contracted, so that their *odorons Steams* do not then break forth from the *Bodies* to which they belong. To which may be added, that the *Air* is thicker and more gross at that time, which therefore the *odorons Steams* are less able to penetrate. Hence it is that *Congealed Bodies* shed no fragrantcy or *smell* at all, because by reason of the obstruction of the *Pores*, the *Steam* cannot disperse it self in the *Air*, nor affect the *olfactory*

Organ. Whereas on the contrary, in the *Summer-time*, *smells* are much better and strongly perceived, because the intense *heat* doth then agitate and excite the *particles*, and sends them in greater abundance to the *Organ*. We observe also, that according as the *wind* is for or against us, so we either *smell odorons Objects*, or not smell them; for when the *wind* comes from those *Objects*, the *smell* of them doth more strongly affect the *Organ*; whereas when it is contrary, it carries the said *odorons Steams* from us, so as that we perceive no Scent at all.

Many *Beasts* excel *Men* in the sense of *Smelling*; and more especially *Dogs*, who not only exceed *Men*, but all other *Beasts* in this regard.

The reason whereof may very probably be ascribed to their *Organ* of *Smelling*, as abounding with very fine and subtil *Fibres*, and those more fitly disposed for the reception of *Odours*. For it is observed that the *Olfactory Organ* of *Dogs* is drier than that of other *Creatures*; because their *Snot* doth not flow the ordinary way, but through some *Pores*, which may distinctly be perceived at the end of their *Noses*. Or else the cause of this more quick *Scenting* that is in *Dogs*, may be attributed to their not being subject to those gross *Fumes* arising from the *Stomachs* of *Men*, who feed upon such various sorts of *Meat*, which hinder the reception or perception of the subtil *odorons Steams* proceeding from *Objects*. Hence it is that *Dogs*, that are too much conversant in *Kitchens*, and are too much fed, do by degrees lose their *Sagacity*, and become much inferior to those who are kept shut up, and are only fed with *Food*, proper for hunting *Dogs*.

Neither is there any question to be made, but that if *Men* lived only upon *vegetables*, they would far excell others in this Sense, who fare more deliciously, and pamper themselves with *Flesh* and variety of *Meats*. Thus Sir *Kenelm Digby*, in his Treatise of *Bodies*, relates this story of one *John* of *Liege*, who fleeing into the *Woods* to avoid the violence of some *Soldiers*, lived there many years, feeding all the while on *Wild Apples*, *Acorns* and *Roots*; who after he had been caught by some *Country People*, after having attained the use of speech, he declared to them, That as long as he lived in the *Woods*, he could by his smelling find out his *Food*, and distinguish that which was good, from that which was hurtful; that by the same he was aware frequently of *Hunters* that had a design to take him, and by this means oft escaped their *Hands*. Which Example makes it evident, that the quickness of the Sense of *Smelling* is spoiled by the vapours of divers and dainty *Viands*; and the chief reason why *Men* are inferior to *Beasts* in this Sense is, because their Diet is not so simple as theirs is.

It may also be allowed, that many *Animals* do exceed *Man* in this Sense, because of the vivacity of their *Organs*; as it is evident in *Ravens*, *Vultures* and *Dogs*, which by their *Sagacity* pursue their Prey, or follow the footsteps of their *Maisters*: *Tigers*, who by their smelling, follow them who have taken away their *Whelps*: *Roughfooted Pigeons*, who by the same sense, fetch back their Young, tho' carried into some House above 200 paces distant from them. Neither is it any

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contra-

XIV.

Dogs exceed Men in the quickness of Smelling.

XV.

Why the Sense of Smelling is weaker in Men than in Beasts.

XVI.

Some Animals are signal for their quickness of Smelling.

X.
Why distilled Waters lose their fragrantcy, when the Flowers from whence they are drawn, are in their Prime.

XI.
The Fragrantcy of things may be separated from their gross Body.

XII.
They who are troubled with Cold, lose their Smelling.

XIII.
Why we perceive the odours of things better in the Summer than in the Winter.

contradiction to what is here alledged, that *Dogs* in *hunting*, are sometimes at a loss, because this only proceeds from the great distance either of time or place in which the *Odour* is diffused, or when the odorous *Streams* are carried away by the *Wind*, or being mingled with other *Streams* produce a confusion.

XVII.
How some
odorous Bo-
dies may
retain their
Scent for a
long time.

It is certain that *odorous Bodies* by continual expiration, become *flaggy* and are consumed; because their substance is continually waisted and dispersed by the exhalations that proceed from them. Yet as to the great, and almost inconceivable subtilty of these *Fumes*, we have a very pregnant demonstration, in a piece of *Ambergris*, which after a continual expiration of *odorous Streams* for several years together, doth to our senses appear to be of the same Bulk. So that it may seem probable, that these *Fumes* do by a continual Circulation return to their source again: Much in like manner as we have shewed in our *Institution of Philosophy*, that the *Striate Matter* moves circularly about the *Loadstone*; according to which *Hypothesis* it may be made out, that an *odorous Body* may continually shed its exhalations without losing ought of its substance by that means.

CHAP. VII.

Of Sound.

I.
Liquid
Bodies
when dash-
together,
make a
noise.

Sound doth not only proceed from *hard* and *Solid Bodies*, but also from *fluid*, and which because of the pliability of their parts, do give way to the motions of other *Bodies*. For the *Air*, when it is struck, conveys a *Sound* to our *Ears*; the *Waves* when they dash against each other, cause a great noise; and all *Waters*, according as they run through a plain *Channel*, or are interrupted with *Rocks* and *Stones*, make a different impression upon the *Nerves*.

The Reason is, because the parts of the *Air*, as well as of other *liquid Bodies*, by their beating against each other, become divided into innumerable small particles, which being most swiftly moved, and dashing against each other, must needs produce a *Sound*. For a *Sound* is nothing else but a trembling and waving motion of the *Air*: And as we see that by the throwing of a *Stone* into the *water* many *Circles* are formed, which uniformly extend themselves to the *Shoar* or *Banks*; so likewise the *Sound* that proceeds from *Bodies* that are struck, is by reciprocal vibrations propagated through the *Air*.

II.
How a
Sound
comes to be
dispersed
round.

Which will more clearly appear in the *Figure*. Let there be supposed a String that is struck, which may be conceived as a *Cylinder*, whereof the semisection will make an *half Circle*, M B R, so as that whilst it restores it self, every one of its points are moved with a strait motion, and by parallel Lines, as A B, P C, O D, N E, M F, Let us then suppose in the several points of this Section some particles of pure *Air*, or Moisture, which may be considered as *Globuli*, or small round Bodies L, K, I, H, G, &c. which touch the Section in the points B C D E F: Now if right Lines be drawn from the Center A, through the foresaid points, they will terminate in the Centers of the *Globuli*; and if one *Globe* fall upon another, it will move the same by a Line joining

Figure 8.

the Centers of both together: So that the Arc M B, of the Section of the *Circle*, diffuseth that most light matter according to the Angle M A B, and in like manner the Arc B R, according to the Angle B A R.

Thus we observe that our *Breath*, when gently sent forth from our *Lungs*, is not heard, nor when it is easily blown through a *Pipe*, because there are none of those frequent wavings, between the sides of the *VVind-Pipe* and the *Pipe*, which are necessary to convey the strokes of them to the *Organ*. In like manner, as we see that a *Hammer* gently applied to the *Anvil*, doth produce no sound at all, because the *Air* is not sufficiently beaten back or undulated, as to produce that frequency of motion that may reach the *Ear*.

III.
Why the
Breath
that is sent
out of our
Lungs is
not heard.

Musical Instruments are commonly made hollow, and often approach to a *Spherical Figure*.

The Reason is, because the passing and repassing percussions of the *Air*, are multiplied in a Hollow, and therefore do the longer detain and please the *Ear*. For in *hollow Bodies*, not only the outward *Air* is agitated by frequent concussions, but also the Internal. The depth also of *Musical Instruments* is of great use, because then *Sounds* are the better mingled in them, and one part being agitated, doth more easily make the other parts partaker of the Motion.

IV.
Why Musi-
cal Instru-
ments are
commonly
hollow.

Thus *Hawk-bells*, by reason of the slit and holes they have on their sides, do yield a greater *Sound*, than when in the open *Air* we strike upon any *Brass Vessel*; because the *Sound* of the *Bell* being pent up within the sides of it, doth break forth whole and strong. And it is for the same reason, that *Musick* within doors in cold weather is more agreeable, because then the *Strings* or *VVood* of the *Instruments* are more wrinkled, as it were, and become more hollow and porous. And on the other hand it is observed, that the *Sound* of *Musical Instruments* is not so distinct in *Chambers* that are *lung*, as in those that are *VVain-scotted*, because the *Sound* doth more briskly rebound from a smooth and hard body, than from that which is soft and yielding. For indeed all soft *Bodies* are less fit for the generation of *Sounds*, and do easily transmit them. And it is for the same Reason, that the *Sound* of *hot Iron* is more dull, than that which is cold, even because it is more soft, and the parts of this latter do yield more frequent vibrations.

V.
The matter
of the In-
strument,
and the
Place, do
contribute
to the variety
of Sounds.

A person that is *Deaf* may perceive the *Sound* of a *Lute*, or any other *Instrument*, whilst he holds the Neck of it between his *Teeth*.

VI.
What is
the Reason
that a
Deaf Man
can per-
ceive the
Sound of a
Lute,
whilst he
holds his
Teeth upon
the Neck of
it.

Some have conceived that this is to be attributed to some conveyances, reaching from the *Mouth* to the *Ears*, which carry the *Sound* thither, and impress the same affection upon them, which is transmitted by the *Organ of Hearing*. But that this is not so, is apparent, because the same effect doth not follow when we hold our *Mouth* open. Besides, if this were sufficient, why might not sounds be perceived by the touch of the *Forehead* or *Nose*; seeing that from these parts there be passages to the *Ears*, and an equal communication between them?

Conclude we therefore, that the *Sound* of a *Lute* can therefore be heard or perceived by those who hold the Neck of it between their *Teeth*, because the vibrations of the *Strings* being trans-

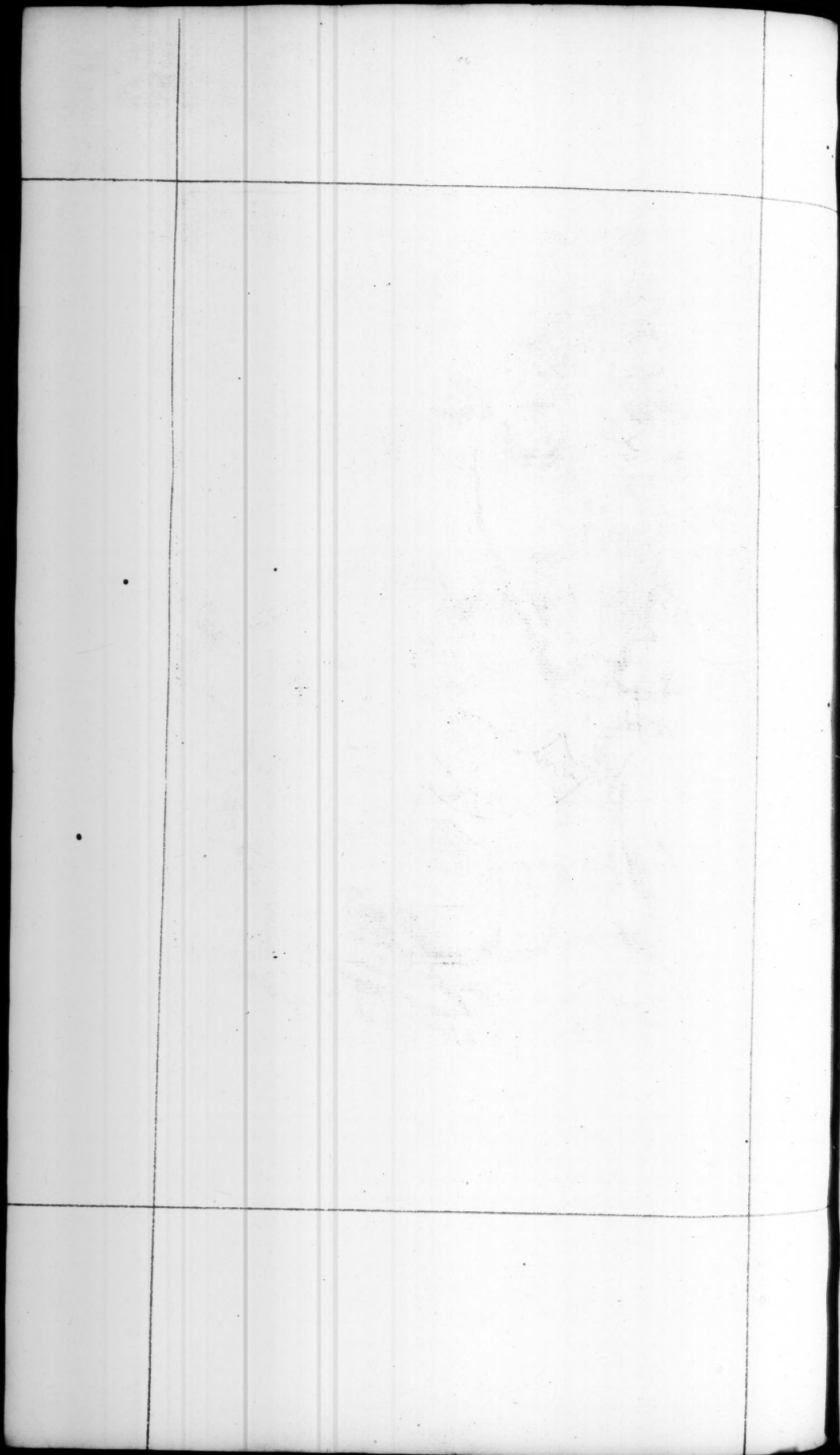
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III.
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it is
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mitted from the *Lute* to the *Teeth*, are from thence communicated to the *Membran* that covers the *sockets* of the *Teeth*, and presently after shaking the *Drum* of the *Ear*, by means of the shut up *Air*, do also agitate the *Connexion* or *Chain* of the 3 *little Bones*. For a *Body* is then properly said to yield a *sound*, when being struck, it performs several *Vibrations* by a tremulous motion, which by the *Vehicle* of the *Air* is diffused through the *Bodies* that are between the *sounding Object* and the *Organ*. For there is a consent betwixt the *Nerves*, which are disperst throughout the inward parts of the *Mouth*, and those which run through the *Muscles* of the *Ear*. An Argument whereof is, that harsh and grating *Sounds*, do stupifie and signally afflict the *Teeth*.

But of all *Sounds*, none are more ungrateful to the *Ear*, and indeed intolerable, than the skreaking Noise of a *Saw*, or the filing of *Iron*.

The Reason whereof is, because the *particles* of the *Air*, which strike against the *Ear*, do, because of their irregular figure, too violently vellicate the *fibres* of the *Auditory Nerves*, so as that thereby they are in danger of being broken, and sometimes break actually, whence that troublesome and painful Sensation doth arise. The same also, tho' in a less degree, is caused by the hearing of false *Tones*, which is extremely offensive to a *Musical Ear*. And accordingly, by means of the foresaid *Sounds* the *Teeth* are sometimes set on edge; forasmuch as by this inordinate undulation of the *Air*, the *Nervous fibres* which are at the Root of the *Teeth*, are in a manner loos'd and separated from their former stability.

If 2 *Lutes* or *Citterns*, whose *strings* are made *Unison*, are placed at some distance from each other, when the *strings* of the one are smartly struck, those of the other tremble also, and that so strongly, that they will shake off a bit of *Paper* laid upon them.

The Reason is, because the *string* being struck by a certain number of *Vibrations*, shakes the *Air*, which lighting upon the *Unison strings* of the other *Instrument*, doth shake it likewise. And this more especially, if the said *strings* be consonant in an *Eighth* or *Fifth*, for then their *Vibrations* will be less confus'd, and agree in their certain and frequent Intervals. For in an *Eighth*, all the *Vibrations* of a more lax and longer Chord or *String*, agree with a *Second*, *Fourth* and *Fifth* of a more stretched and shorter Chord; in a *Fifth*, with a *Third*, *Sixth* and *Ninth*, and so of the rest.

Wherefore this *Trembling motion* never follows where two *Strings* are differently tuned: Whereas *Concords* do not only excite each other, but others also, by reason of the similitude of their motions, and do so assist each other, as mutually to impart the same Affections. As may be experienced in any *Musical Instrument*.

It is a common Report amongst the many, that there is a *White Gunpowder*, with which *Guns* may be discharged without giving any Report.

This, tho' very confidently asserted, appears to be a meer figment. For it is impossible that the pent up *Air* should be able to break forth without making a Noise: For that which is of such a force as to be able to drive a *Bullet* with as great swift-

ness, as the *Flame* breaks forth from the *Gunpowder*, must needs strike the *Air* with a like force, and consequently produce an answerable *Sound*.

Of all *Animals*, *Men* and *Birds* only are able to make *Musical Sounds*.

The Reason hereof must be fetch'd from the structure of the *Throat* and *Wind-pipe*, the *Rings* whereof in *Men* and *Birds* are capable of being contracted and extended. For there is a double recurring *Nerve* in the *Wind-pipe*, which turning round about it, doth by the help of some of its Branches move the *Rings* of it downwards; and forasmuch as the same is terminated in the *Nerve*, proceeding from the *Plexus Gangliiformis*, it moves the folds of the *Wind-pipe* upwards. So that whilst the *Rings* of the *Wind-pipe*, by means of the recurrent *Nerve*, are moved downwards, it causeth a deep or bass *Tone*; which becomes more high and shrill, when the said *Rings* are rais'd higher by the Branches of the 6th pair of *Nerves*, disseminated in the *Wind-pipe*; because the *Wind-pipe* being straitned by this means, doth in a manner break the *Sound* that passeth through it.

If a *Lute* be play'd upon near a *Smoking-Candle*, the same motion of the *Strings* will be communicated to the *Smoke*.

The Reason hereof is, because the trembling *Vibrations* of the *Strings* do move the fluctuating *Air*, by the reiterated onsets whereof, the *Flame* (which of it self is very moveable) begins to be shaken, and to conform it self to the motions of the *Strings*. Hence it is, that when a *Ray* of the *Sun* is let in into a dark Room, and a *Musical Instrument* be plac'd upon near the said *Ray* or *Sun-beam*, the *Motes* in the *Sun* will be seen to leap and skip in the *Air*, and, as it were, to dance to the *Musick* of the *Instrument*. The same may be also observed in the *Water*, when the *Surface* of it is very smooth and even; for then upon the Noise of *stringed Instruments*, it will become ruffled and curled. The same also may be observed in 2 *Glasses*, into which if we put *water* to the height of 1 or 2 *Fingers* breadth, and bring them to an *Unison*, (which may be easily done by the *Ear*, in drawing our *Finger* round the Edge of them;) for then, if we fix a *Crooked-Pin* upon the Brim of one of the *Glasses*, we shall see it move and skip, as we press the Brim of the other *Glass* with our *Fingers*.

Musical Sounds are not so conducive to provoke *Sleep*; as the Humming of *Bees*, the Noise of the *Wind*, the *Murmur* of *Running-water*, and an equal and smooth *Tone* of *Reading*.

For seeing that the *Sound* is diffused from the Sonorous *Body* to the *Drum* of the *Ear*, and from thence to the *Acoustick Nerve*, and so to the *Brain*, the Center of the *Nerves*, and last of all from thence to the *Arteries*, *Veins* and *Guts*, it cannot be but that the *Blood* and the *Spirits* must be moved also: And because *Musical Sounds* are not carried with an Equal Course, nor do pass by the *Ears*, they do affect the Sense of *Hearing* more than other *Sounds*, and more awake the Attention, which is the reason that they are not fit for the provoking of *Sleep*.

without Noise.

X.
Why Men and Birds only can give forth Musical Sounds.

XI.
The Smoke of a Candle, is agitated by the motion of the Strings of a Musical Instrument.

XII.
Tones, or Musical Sounds, are not so proper to cause sleep, as some other Natural sounds.

Long

VII.
Why a grating, skreaking Noise is very offensive to the Ears.

VIII.
What is the Reason why, when the one of two Unison Strings are struck, the other trembles.

IX.
Whether there be such a thing as white Gunpowder, where, by Guns may be discharged

XIII.
Musick
corrupts
Manners.

Long Experience hath taught, that soft and Effeminate strains of *Musick*, are very proper to corrupt the Manners of men: Whereas, on the other hand, the Sound of *Cornet*, *Trumpets* and *Drums*, do fill Men with a Courageous and War-like Spirit.

For seeing that *Human Affections* are nothing but *Sensations*, produced by the motion of the *Spirits*, we need not wonder that the *Sound* arriving at those *Vessels* in which the *Passions* are generated, should produce various *Passions*. And forasmuch as the *Manners* of Men commonly follow their *Passions*, it is evident that *Sounds* must needs be of great use, either for the corrupting or correcting of Mens *Manners*. Accordingly *PLATO* was of Opinion, that all soft *Tunes* ought to be banished out of a well-governed City. And the *Lacedaemonians* assign'd a great Punishment to those that used any soft or effeminate kind of *Musick*; and made a *Law*, that none should play upon a *Harp* that had above 7 strings.

XIV.
Why upon
the stop-
ping of our
Ear, we
hear a
kind of
humming
Noise.

When we stop our *Ear* with our *Finger*, we suddenly hear a buzzing kind of *Noise*.

Because it is owned by *Physicians*, that a *Steam* or *Vapour*, doth proceed out of the Hollow-winding of the *Ear*; so that when the *Ear* is stop't, this pent up *Steam*, as well as the *Air*, seeking to get out, do beat and distend the *Drum* of the *Ear*; from which Motion, an Affection is produced like to a great *Buzzing*. Yea, it is frequently found, that the *Ears*, tho' not stop't by our *Finger*, are fill'd with this *Buzzing Noise*, produced by the blast of a most thin *Steam* or *Vapour* breaking forth from some little *Artery* or *Vein*, which striking against the *Drum* of the *Ear*, affects it much in the same manner, as it would be by the sound of a *Bell*.

XV.
Sound
more easily
passeth
through a
Beam of
Wood, than
through
the Air.

A *Sound* is more easily diffused through the length of a *Beam*, struck at one end, than through the *Air* only. For as soon as one end of the *Beam* is moved, in the same instant the motion is communicated to the other.

Figure 9.

The Reason is, because there is a greater *Continuity* of Parts in the *Beam*, than in the *Air*. For, when you move one end of the *Beam* A, at the same time the other B is moved also; but if you push the *Air* at C, it must at least move as far as D, before it can move E; because all its parts give way like a *Sponge*; and because it takes up some time in passing from C to D, it loseth also part of its Force. Whence it comes to pass, that the *Sound*, which is nothing else but a motion of the *Air*, is both sooner and more strongly heard at the Point D, than at the Point E.

XVI.
Why
Sounds are
more clearly
and
distinctly
heard near
the Banks
of Rivers.

Which is the Reason why the sounds of *Great Guns* and *Bells*, are more distinctly perceived along the *Banks* of *Rivers*, than when we are at a distance from them; and it is universally true, that all and every sound is both sooner, and at a greater distance, communicated by *water*; for the parts of the *water* being more close and stiff than those of the *Air*, when once put in motion, do communicate their Force to others. To this moreover may be added, the smooth surface of the *water*, which doth not in the least break or turn aside the sound. Thus by laying our *Ear* to the ground, we can perceive the trampling of *Horses* at a great distance; and if a *Drum* be set upon the *Ground*, and the *Ear* laid to the upper Skin of it,

the Noise of the marching of *Horses* can be perceived at some Miles distance.

The Voice of a *Preacher* in a *Church*, or *Astor* upon a *Stage*, reacheth the *Ears* of some Thousands of his *Hearers*.

This is not, because the whole Voice of one man comes to the *Ears* of all that hear him; for the *Voice*, as soon as it comes forth out of the *Mouth*, is broken into many parcels all like the whole; much in like manner as when *Fullers* spout out *water* out of their *Mouths*; for then the *water* is dispersed into innumerable drops, and fills a very large space. From the *Mouth* of the *Speaker* an entire Voice doth indeed proceed; but is afterwards divided into innumerable *Voices*: And therefore sure it is, that no two *Auditors* receive the same Voice, tho' they be said to hear the same, because of the likeness of these divided partial *Voices*, with the entire or total *Voice*. In the same sense, as they are said to drink the same *Liquor*, who drink out of the same *Fountain*.

XVII.
How the
Voice of
one man
comes to
be diffused
to the Ears
of so many.

Tho' Experience shews, that the whole *Atmosphere* of the *sonorous Body*, is moved to such a proportionate Circumference; yet is not the said fluctuation of the *Air* equally diffused through all parts of the *Air*, but the sound seems rather to be carried along some certain *Tracts* or *Currents*. And therefore it is that the Words of a *Preacher* or *Oratour*, tho' they move the whole *Atmosphere* of the *Auditory*; yet it agitates that *Tract* most which his *Mouth* more directly answers to, where the *Auditors* do also more distinctly hear his *Voice*, than those who are more remote from that *Tract*. Thus it is well known, that those only hear the hissing Noise of a *Bullet*, discharg'd from a *Musquet*, who are near to the *Line* described by the *Bullet*, whilst those who are at some distance perceive nothing of it.

XVIII.
Sounds are
diffused
along some
certain
Tract or
Currents,
more than
others.

Sounds that are excited in any one place, be they Loud or Low, are in equal time conveyed to the place, where they are heard.

XIX.
Sounds are
equally
diffused.

The Reason is, because the *Air* being a *Continuous Body*, when struck, is formed into *Orbs* or *Circles*: As we see that *Still-water*, when a *Stone* is cast into it, becomes waved into *Circles*; and as the said *Circles*, at an Equal distance, spread themselves to the *Banks*, whether they be caused by a little or great *Stone*; so likewise doth the sound, at an equal distance of Time, come to the *Ear*, whether it proceed from a great *Gun*, or a *Musquet*, or any other thing.

It sometimes happens, that 2 Sounds are heard, when one only string is struck.

XX.
Whence it
is that
a double
Sound is
perceived
from the
striking of
one String.

This proceeds from some defect in the string, which when they are false and uneven do admit 2 several kind of *shakings*: at one and the same time, whereof the one, and which gives the deeper sound, proceeds from the whole string; the other, which affords a more shrill sound, depends on the unevenness of the string. Suppose, for Example, that when the string A B is struck, as often as it passeth and repasseth from 1 to 6, to produce its *Natural sound*, at the same time the Unevenness of its parts produce another *shaking* in it, by means whereof, when it hath moved from 1 to 2, it runs back to 3, and from thence towards 4, and from 4 to 5, and lastly to 6, which produceth a sound that is by a *Twelfth* more shrill than the former:

Figure
10.

former: In like manner, if the *second* shaking be only double to the former, it will yield an *Eighth*; if *Quadruple*, a *Fifth*; and if *Quintuple*, a *Seventeenth* more than before.

XXI.
Why we
see the
Lightning
before we
hear the
Thunder.

A *Sound* takes more time to arrive at our *Ears*, than the *Light* to come to our *Eyes*; which is the Reason why we perceive the *Lightning* before we hear the *Thunder*; and we see the *Ax* of one that hews *Timber*, when we are at some considerable distance, lifted up to make a second stroke, before we hear the first.

The Cause whereof is the *Air*, which altho' it consist of *subtil parts*, and divided from each other; yet being withal *Branchy* and *flexible*, when one of them is moved, the other parts are not presently moved at the same instance, but by degrees; so as that one part being agitated, pusheth on the next, and so on; like the *Circles in the Water*, which do not in an instant spread themselves over the whole *surface* of it, but proceed in a continual order till they come to the *Banks* of the *River*, or that they cease upon the failing of the force, which caused them at first. But *Light* is much more swiftly conveyed to our *Eyes*, as being caused by inflexible and solid *Globuli*. For it is the Nature of *solid Bodies*, that when one end of them is prest upon, the said preffion is felt at the same moment of time, at the other end of it. Whence it is that, as was said before, a *Sound* is sooner conveyed through a whole *Beam*, than through the *Air*; because the *parts* of the *Beam* are more closely joyned together, than the *parts* of the *Air*, which are flexible, and easily give way to other *Bodies*.

XXII.
Strings of
an unequal
length,
yield a
different
sound.

Let there be 2 *Strings* of the same thickness, and wound-up at the same height, whereof the one is longer than the other; that which is the shorter of the two will yeild the shrillest, or most treble *sound*; and the longer, the deeper *sound* and less perceptible.

This difference of the *Sound* proceeds from the more frequent, or fewer *Vibrations* of the said *strings*: For seeing that a *shorter String* makes more wavings, and beats the *Air* with more reiterated strokes, by so much shriller is its *sound*, and the sooner it conveys the *sound* to the *Ear*. Because the difference of a deep and shrill *sound*, doth not proceed from the more swift or slow motion of a *string*, as *ARISTOTLE* was of Opinion, but from the variety of the *Vibrations*, which, if they be frequent, produce a treble or shrill *sound*; but if fewer, are the cause of a deep or bass *sound*.

In like manner we may give an account, why the lesser of 2 *strings* that are wound-up alike, but of different length, makes its *Vibrations* more swiftly. The Reason is, because tho' both the *strings* make their Excursions with an Equal motion, with respect to Space and Time; yet because the lesser, by its motion of Contraction, runs through a less space than the longer; and that a less Space is sooner run through with an Equal motion than a Greater, it must needs be that the motion of the Lesser Cord be swifter.

XXIII.
Why the
Sound
ceaseth
upon touch-
ing the
Strings

Whence it is evident, that if you lay your *Finger* upon a *String* presently after you have struck it, before it have made many of its *Vibrations*, you will indeed hear some kind of Noise, but without being able to distinguish whether it be

shrill or deep, because your *Finger* hinders the *Vibrations*, and doth not suffer the *string* by its preffion to dilate the *Air*, and to drive it away by a successive beating of it. Hence it is that a slow and soft blast, blown into a *Pipe*, produceth no *sound*, nor that which from the *Lungs* is breathed out by the *Mouth*; because there is no rebounding of the *Air*, between the sides of a *Pipe*, nor in the *Wind-pipe* or *Mouth* of an *Animal*, which bounding this way and that way, is the cause of a *sound*; and according as their Repetitions are more swift or slow, so they produce either a *shrill* or deep *sound*.

An *Eccho* doth frequently repeat the same *Voice*, and renders the same *sound* at distinct Intervals. So *CLAUDIAN* makes mention of one that rendred the *Voice* no less than 7 times: And *GASSENDUS* tells us, that he had Experienced, that in the *Chapel of Charenton*, which is about 3 or 4 Miles distant from *Paris*, one *Syllable* pronounced at either end of it, was repeated 17 times, and that the same word spoken in the midst of it, was as many times repeated from both Sides.

The Cause of this is, the Reflection of the *Sound* from some interposed let or hindrance: For as innumerable Rays are conveyed from the visible Object, not only to the *Eye*, but every way round; so besides the *Voice* which is carried to the *Ear*, innumerable other *sounds* are dispersed in the *Air*, which meeting with hard and concave *Bodies*, are dispersed through the *Air*, which makes the same *Voice* to rebound several times. For *Sound* is not conveyed like the *Light*, in one moment, but stands in need of time, to propagate it self: And therefore when the former *sound* becomes extinct, or vanisheth in the neighbouring *Air*, another is generated in that which is farther off; which being reflected from solid and tolerably smooth *Bodies*, doth frequently beat the *Air* that is nearer the *Ear*. A *Sound* therefore is oftentimes repeated by the *Eccho* in the *Chapel at Charenton*; because the place there is so disposed, that the nearer places do first repeat the *Voices*, and the more distant afterwards. It conduceth also to the forming of an *Eccho*, that the *Bodies* which reflect the *Sound* be opposite to each other, and send back the same by turns; as it was in the *Chapel at Charenton*, before that the *Monastery* of the *Carmelites* was built there: For at that time there was a double Row of *Pillars*, between which the uttered *Voice* was rebounded; much like a *Ball*, which lighting against one *Wall*, rebounds thence to the other.

Tho' the *Eccho* be a *Sound* which is every way circularly extended, yet can it only be heard in one part of the *Circle*; because it can only be received from the Reflexion of that part of the *Circles*, which is the farthest extended, and in that part where the said Reflexion is made. As we observe, that when a *Stone* is cast into a *River*, the *Circles* which are there formed; are further extended towards that part, where the *Stone* was cast in, than towards the opposite.

A *Sound* that hath been frequently rebounded, is preserved or continued a longer time, than that which without repercussion is propagated in a Right line.

The Reason is, because by the several *Bodies* and Cavities against which the *Repercussion* is

X x x x x

with ones
Finger.

XXIV.
Why the
Eccho re-
peats the
same Voice
several
times.

XXV.
Why the
Eccho is
heard only
in one
part.

XXVI.
A reflected
Sound is
of longer
continu-
ance, than
one that
is not
reflected.

made, the *sound* is strengthened and increased, and therefore is longer a vanishing, than if it were only extended in a Strait line, without repercussion. Moreover, it is evident from the Observations of many, that in the *Village of Simonetta*, about a mile distant from *Milan*, the *Voice* is often repeated 30 times, and in every one of its passings and repassings, it runs through 156 Paces and upwards; whence it follows, that the same *Voice* being separated 32 times, before it be altogether extinguish'd, must run through 5002 Paces and upward. From whence it may be easily gathered, that the *sound* must needs be greatly increased in the said Concavations, by means whereof it is enabled to continue so long, seeing it doth not seem possible, that by continual direct Motion, a *sound* should be able to reach 5 Miles, in which motion of the *sound* 25 Horary minutes must be spent.

XXVII.
A Sound is hindered by the Interposition of a solid Body.

When a Man speaks to another, a thick *Glass Window* being between them, his *Voice* will scarcely be heard; but if there be only a *Paper Window* between them, the *Voice* may be well enough discerned.

The Reason is, because the *sound* is an effect of the motion of the *Air*, and therefore because little or no *Air* can pass through the pores of the *Glass*, the *Organ of Hearing* cannot be affected thereby. Forasmuch as the intervening *Glass* is supposed to be so firm, that it is not capable of being shaken by the *sound*; whereas the *Air* easily passeth through the pores of *Paper*, especially if the same be stretched, because by this means it is the more easily shaken, and its pores are made more lax and open.

XXVIII.
A Bell, when struck on the upper part of it, yields a shriller sound, than when hit lower.

A *Bell* yields a more shrill *sound* when struck on the upper part of it, than when it is hit Lower.

The Reason is, because the hollowness conduceth to the Deepness of a *sound*; and because the further that the *sound* is propagated the more Bass or deep it is. Thus the lower Holes of a *Recorder* afford a deeper *sound*; for the slower the beating of the *Air* is, the deeper is the *sound*. As we find that the more *water* there is in a *Glass*, when we press our *Finger* round the Edge of it, the more shrill the *sound* is, for then the Vibration of the *Air* is the swifter, as when less *water* is in the *Glass*, so much the more deep the *sound* is.

XXIX.
How it comes to pass, that Glass may be broken by a Voice or sound.

It is observed, that a *Drinking Glass* may be broken by a man's *Voice* only, and that by reason of the repeated Vibrations of the parts of a more solid Body. For the effecting whereof, first, we must try by a stroak with our *Finger*, what Tone the parts of the *Glass* do yield, and then must set our *Voice* as near as we can to the same Tone, and increase the same by degrees, till we come beyond a *Diapazon* or *Eighth*: Whereupon the insensible parts of the *Glass* being struck with iterated stroaks, become agitated by a tremulous motion, which increaseth as they are struck in fit places, so that at last, by the augmentation of the force of the *sound*, the parts of the *Glass* leap asunder. But for this Experiment, a smooth and even *Glass* must be made choice of, and such as when filipt with the *Finger* doth not *sound* so shrill, but that the *Voice* of him that sings, may equal it, or go beyond it.

Sir KENELM DIGBY relates in his *Treatise of Bodies*, that he had seen the Walls of a large and round *Tower* (tho' I rather suppose it to have been of an *Elliptical figure*) which were so Artificially built, that 2 men standing at the opposite points of the *Diameter*, might easily and distinctly talk together, whilst those that stood in the midst, could not perceive the least of any thing that was spoken.

The Reason of this must be fetched from the Coition or meeting of all the *sounds*, which are dispersed through the whole Room: For seeing that all the *Air* in the Room is shaken by the uttered *Voice*, the motions thereof being diffused through that large Space, are reflected from the Wall of an *Elliptical figure*, and so by Reflexion become united in the uttermost part of the Chamber; and therefore he that lays his *Ear*, must needs hear the *Voice* of him that speaks at the other end, tho' with a very Low *Voice*.

Upon the same account it is, that by means of a *Pipe*, contracted in manner of a *Cone*, *sounds* may be increased, and made to be heard further off, better than nearer hand; and this, because the *sound* is increased proportionably, as the *Tube* is contracted; for by this means the *sound* must needs be increased in its passage through the *Pipe*. And accordingly they who are *Deaf*, make use of a *Horn*, whereof the one end is wider than the other, which they apply to their *Ear*, by it to receive the *Voice* of him that speaks to them. And by this means, a *Prince* might easily hear the *Voices* of those that walk in his *Garden*, by having *Pipes* conveyed from thence to his *Closet*, the widest Mouths of them being set outward, and the narrowest inward.

The *Stenterophonick Tube*, sometime since Invented by Sir SAMUEL MORELAND, which carries the *Voice* to the distance of a Mile or two; and that other *Trumpet*, which ALEXANDER the Great made use of, in giving Orders to his *Army*; whereof the Figure is to be seen in an Ancient Manuscript of the *Vatican Library*, are made after another manner; for they are streight or narrow at the Mouth, to the end that the particles, which are to make the Reflexion, being close together, may be the more easily beaten, and from thence the *Trumpet* grows wider and wider to the very end of it, in order to augment the agitation of the *Air*, by the multiplication of all the Reflexions which are made throughout the whole length thereof; yet with this Circumstance, that the Bore of the *Pipe* might be so great, and the *Trumpet* so long, that the *sound* would be no longer increased, because the Reflexions would become so weak, as not to be longer in a condition to move the particles of the *Trumpet*, and consequently cause a new Reflexion.

Swarming Bees are recalled by beating upon *Frying-pans* and *Sitbes*.

Some suppose the cause hereof to be, because Bees are delighted with these *Noises*, and being thereby allured, do all unite themselves in one great hanging Bunch or Cluster. But this is not at all probable, because when the Bees are got up into any height of the *Air*, how much soever the said Instruments may be beaten, this will not bring them down, or hinder them from flying away.

Where-

XXX.
Why a Sound can sometimes be better heard by one that is at a distance, than by him that is nearer.

XXXI.
How a Sound becomes increased by the means of a Pipe.

XXXII.
How a Sound comes to be propagated at that great distance by the Stenterophonick Tube.

XXXIII.
Why Bees, when they swarm, are recalled by a Noise.

Wherefore the true Cause hereof seems to be, because the *Air* being much shaken, and agitated with the *Sound*, the *Bees* not being able to bear the same, are forced to unite themselves and settle in a heap. For *Bees* have very thin *Wings*, not feathered ones like *Birds*, but consisting of a thin *Skin*; by means whereof they cannot endure this concussion of the *Air*: Which probably also is the reason, why they never leave their *Hives* when there is a great *Wind*, or at *Midnight*, but only in calm and hot weather.

CHAP. VIII.

Of Light.

I. Light may be excited without a Luminous Body.

UPON the rubbing of our *Eye*, tho' it be shut, there appears a round spot of *Light*, and the same will be by so much clearer, the nearer the rubbed part of the *Eye*, is to the bottom of it.

This is an *Argument* that *Light* doth not exist without the *Eye*, but is only in the *Eye* of him that sees; and consequently that the *Bodies*, which are commonly called *Luminous*, are only said to be such Potentially; that is, in case they strike the *Eye* of the *Seer*: So that if there were no living *Creatures* in the *World*, which could see the *Light*, neither could any *Light* properly be said to be in it. And therefore we must conclude, that *Light* is not in the *things* which are called *Bright* or *Luminous*, but in him that perceives it; in like manner, as *Pain* is not in the *Sword*, but in him that feels it.

II. Why the Rays of Light, by passing through a narrow hole, do cross each other.

The *Light* passing through a small hole into a *Dark Room*, enters the same cross-wise.

The Reason is, because the *Rays* flow from each point of the *Lucid Body*, in *Right Lines*: Wherefore because the *Object*, without the hole, is bigger than it, it is impossible the *Rays* should pass through it, without crossing each other; and by this means it comes to pass, that the situation of the whole *Lucid Body* is represented upside-down, on an *Opaque Body*.

III. Light passing through the holes of two Walls, is not perceived by those who are in the Room.

Let a hole be made in one of the *Walls* of a *Room* of that bigness as may admit the flame of a *Torch* or *Candle*; and just over-against the said hole, let another more large be made in the opposite *Wall*; then in the *Night* let the *Flame* of a *Candle* be held on the outside of the less hole, so as that the *Rays* that pass through it, may be admitted by the opposite hole, and pass through it also; by which means the whole *Chamber* will continue dark, as if no *Rays* at all were transmitted through it.

The Reason of this *Experiment* is, because none of the *Rays* that pass through the *Chamber*, do reach the *Eye*, nor affect it; and yet must, before any *vision* can follow. And for the same Reason it is, that those who in a clear *Night* lift up their *Eyes* on high, perceive all spaces above the *Horizon* to be equally covered with *Darkness*; when as yet those immense *Spaces*, except only that part of them which is vail'd by the *Cone* of the *Earth's Shadow*, are no less guided by the *Sun*, than they were at *Noon-day*. And this because the *Rays* which are diffused through those immense *Spaces*, cannot reach our *Organs*, nor produce any motion in them.

From which *Experiment* it is evident, that the *Light* depends on the *Eye*; so that if there were no *Eye*, or no *Eye* open, neither could there be any *Light*, or *Brightness*, such as we perceive when we lift up our *Eyes* to *Heaven*, and behold this most beautiful appearance of *things*.

A *Spark* of *Fire* sheds its *Light* through a very large space. For a *Spark* of *Fire*, without any *Prospective Glass*, may be perceived in the *Night*, at the distance of 500 paces; and with a *Prospective* may be discerned at the distance of 50 Leagues, and probably much farther.

It seems strange to some, that such a small *Lucid Body* should be of so great a force, as to push the intervening matter of the Second Element in a *Right Line*. But this their wonder will cease, if they consider that this subtil matter, which is diffused through the *Pores* of *Diaphanous Bodies*, is like a most *Fluid Liquor*, whereof one part cannot be prest upon, but that all the part must be moved by it. As for Example, let there be a double *Tube* or *Pipe*, *ABC*, filled with *water*, and of a length as great as you please; if whilst the *water* is at rest, and destitute of all motion, you put a drop of *water* into one of the ends, viz. *A*, no *Body* will deny but that the weight of that one drop will be sufficient to raise the *water* towards the other end *C*, and consequently to put the whole mass of *water* contained in the said *Pipe*, *ABC* into motion.

And for the same Reason, who will not acknowledge that a *Spark* of *Fire* may be sufficient to agitate the *Heavenly Matter*, diffused through a large space of *Air*? Forasmuch as the action of *Fire* doth far surpass the force of *Gravity*; as also because the subtil matter which is contained within the pores of the *Air*, and of the *Water* too, is more fluid than either of them. Wherefore it is evident, that the flame of a *Candle*, must needs move the subtil matter that is contain'd in the round of 50 leagues *Diameter*; forasmuch as by the force of its motion it pusheth the circumambient *Air*, much in the same manner, as a *Stone* that is whirl'd round in a *Sling*, prestheth down the bottom of it; and by the virtue of its *Circular motion*, doth extend the String of it in a straight Line. For the subtil matter, which on every side surrounds the *Spark*, is also turned round, and strives to withdraw from that place.

But from this Explication of *Light*, no small Difficulty seems to arise, viz. how it comes to pass, that the *Spark* which pusheth the subtil matter contained in the *Pores* of the *Air* to *Right Lines*, can be perceived, when another of the same force and virtue is opposed to it. For let us suppose some one *Globule* of the *Air* *ABCD*, whose Center is *E*; and at *A* and *B*, 2 *Lucid Bodies* of the same force, it will follow, that either the said *Lucid Bodies* will not be perceived from the opposite places *C* and *D*, which is contrary to *Experience*; or that the subtil matter in the Center *E*, will be in many places at once, which is repugnant to the nature of *Bodies*. Which may be thus proved; *A* cannot be perceived at *C*, but that the subtil central matter *E*, must be push'd towards *C*. in a straight Line: And by the same reason *B* cannot be seen at *D*; but that the same matter *E*, must be driven towards *D*; and the same

IV. There can be no Light without the Eye.

V. A Spark of Fire, by means of a Prospective may be perceived at 50 Leagues distance.

Figure 11.

VI. How it comes to pass, that the Rays of Light do not hinder one another.

Figure 12.

same may be said of infinite *Lucid Bodies*, placed on the surface of that *Globe*.

This *Difficulty* only ariseth from hence, because it is hard for us to apprehend how the parts of *Liquid Bodies* can receive various actions at one and the same time; because we have observed, that a *hard Body* cannot at the same time be moved divers ways at the same time. When yet in *liquid things* we know it is so; as may be seen by Experience in 2 or 3 *Tubes*, by Example AC, BD, FG, whose *Diameter* I suppose to be equal, and which are so placed crossing one another, as that the space in the middle E, be common to them all 3, and yet no greater than if it served only for one of them. For let us suppose that 3 *Men* do blow into the ends of all 3 of them ABE, the *Air* which is in the midst of these 3 *Pipes*; E will at the same time be driven towards C, D, and G. Not as if therefore it were possible, for every one of the said parts to remove at the same time to these 3 several points; but it is sufficient if some one of them be moved towards C, others towards D, and others again towards G, and that 3 times swifter, than those that fill the other parts of these *Pipes*; which is credible enough, forasmuch as they are with triple stronger force push'd forwards. Now to apply this to the subtil matter, it will by this instance be easily conceiv'd, how the same transmits the different Actions of various *Lucid Bodies*, to different parts at one and the same time.

VII.
How it comes to pass, that a Man who shakes a Torch, doth at the very same instant perceive the same in an opposit Looking-Glass.

When a *Man* in the *Night* hath a lighted Torch in his *Hand*, and shakes it towards a *Looking-Glass*, at a quarter of a miles distance, he will no sooner perceive the shaking in his own *Hand*, but that at the same time he will perceive it in the opposit *Looking-Glass*.

The Reason is, because *Light* is rather an endeavour or tendency toward motion, than motion it self. For tho' motion cannot be performed in an instant; yet is it not repugnant, for the action of *Light* to be transmitted in a moment at any distance whatsoever. For it is one thing to say, that motion is performed in an instant, and another, that *Light* is transmitted in an instant. The *Light* is transmitted after the manner of the Action of a *Stick*, every part whereof may be perceived or felt, at either end of the *Stick*, at the very same instant wherein it is produced. And consequently nothing hinders but that a lighted Torch, being shaken, may be perceived in a *Looking-Glass* at a distance, at the same instant that the shaking is felt in the *Hand*; because the propagation of *Light* is momentaneous, and needs no time for its passage.

VIII.
Why a certain Stone, found near Bononia, doth retain a Light in the Dark.

Some *Stones* shine in the *Night*, especially the *Diamond*. There is a *Stone* very common in the Country about *Bononia*, which if it be gently calcin'd, and afterwards expos'd to the *Sun*, doth take in so much *Light*, that when put into a dark Room, it is observed to retain some part of it, much like a glowing Coal that is covered with a little *Ashes*, the *Light* whereof decreaseth by degrees, and is at last quite put out.

We must not imagin, with some, as if the *Light* of the *Sun* were preserved in the foresaid *Stone*; forasmuch as that *Light*, upon the withdrawing of the *Sun*, doth altogether vanish, as not being able to subsist a moment without its

presence; but rather conclude, that within the Pores, made by the *Fire* in the said *Stone*, there be some *Fibres*, so very moveable, as that upon the presence of the *Light* they are put into a great agitation, and upon the withdrawing thereof do still continue the motion impress'd upon them; and consequently move the surrounding Globuli of the Second Element. And therefore, when either in process of Time, or by the strength of *Fire*, such *Fibres* are taken away, that *Luminous Virtue* immediately vanisheth. The *Light* of this *Stone*, as was said, can only be perceived in a *Dark Room*, because it is very weak, and therefore easily overcome of a stronger *Light*. As is evident in *Rotten-wood*, *Crickets*, and other things that shine in the *Night*, which by Day give no *Light* at all.

The Reason why a *Diamond* shines in the *Dark*, seems to be this, because in the Pores thereof the particles of the 3d Element are so compress'd, that those of the 2d Element being push'd out, some of them are surrounded only with the 1st Element, by which they are carried away, and the Globuli are driven or push'd forwards.

When we receive a knock on the *Head*, or a blow on the *Eye*, we seem to perceive many Sparks of *Light*.

The Reason is, because the motion of the Globuli is very much accelerated by the striking *Fist*, which makes them break forth from the *Eye* with great force, and so cause the appearance of those Sparks, which we see at that time. For by means of such a stroke, the *Humours* are put into a great Commotion, and more especially the Arterial Blood, which driving with a great force against the Optick Nerve, seems to exhibit the appearance of many Sparks of *Light*. For the Sense of Seeing is nothing else but a local Motion, or rather Pressure, whereby the fine filaments of the Nerve-like Coat of the *Eye* are struck.

The Affection which the *Light* impresseth upon the *Eye*, doth continue for some time. For when we shut our *Eyes*, after we have beheld the *Sun*, we think we see an appearance of several Colours.

The Reason whereof is, because the fine *Fibres* of the Optick Nerve, do still continue agitated by an unusual motion. But forasmuch as the said Commotion wherewith they are shaken, even after that the *Eyes* are shut, is not strong enough to afford such a clear *Light*, as that is from whence it did proceed, therefore it represents only to us some weak Colours. And for the same Reason it is that some persons do perceive some kind of *Light*, for some time after that a *Light* hath been put out. Yea sometimes, tho' there be no *Lucid Body* to affect the neighbouring *Air*; yet sometimes some sharp *Humour* or *Vapor*, only moving the Filaments of the *Retina*, causeth an appearance of *Light* to the *Eye*.

The *Light* of a *Candle*, doth appear greater at *Night*, than in the *Day-time*, if the *Eye* be at some distance from it.

This may proceed from 2 Causes. First, It may be occasioned by something in him that sees, who when he doth not exactly know the distance of the *Candle*, may imagin that it is as far from him as a *Star*. Moreover, seeing that the Image of a *Candle*, framed in the bottom of the *Eye*, doth

IX.
Why a Diamond shines in the Night.

X.
Why it is said when a Man is struck on the Head, he perceives Sparks of Light.

XI.
Why if we shut our Eyes after that we have, for a good while, been gazing on the Sun, we perceive an appearance of Light or Fire.

XII.
The Light of a Candle doth appear more at Night, than in the Day time.

doth much exceed that of a *Star*; it may make him think that it is really greater than a *Star*. Another Cause of this mistake, may be from the thing it self which is seen. For when at *Night* we look upon a *Candle*, that shines at a distance, we do not only perceive the *Light*, which comes to the *Eye* in a straight Line, but that also which proceeds from the *thick Air*, and the *Opake Bodies* that surround it; for they also convey to the *Eye* the *Light* they have received, which being ascribed to the *Candle* it self, it cannot but appear much greater, than indeed it is.

XIII.
Why some
Worms and
Flies do
shine in the
Dark.

Some *Worms* and *Flies* do shine in the dark, shedding a kind of *Brightness* from their *Bodies*, through the *Air*.

It is probable that these *Insects* have a certain matter exhaling from them, that resembles the sweat of other *Animals*; and that the same pusheth the *Globuli* of the 2d *Element*. And this seems to be the more probable, because these *Animals* cease to shine as soon as they are *dead*.

XIV.
Some Plants
do shine.

Thus we see that *Rotten Wood* appears shining and *Bright* in the *Dark*, because by the access and recess of its parts, the *Pores* thereof are so straitned, that they contain nothing else but the first *Element*, whereby the 2d is agitated. Thus *Sea-water*, being vehemently driven and beaten with *Oars* and *Storms*, doth appear all on a flame, because the *Sea-water* doth consist of stiff particles of *Salt*; for by these penetrating little *Bodies*, the particles of the 2d *Element* they meet with in their way, may be so expelled, as that some of the particles of the 3d *Element*, may be only surrounded with the 1st *Element*, and by it be carried away, and driven on to the *Eye*, by a continued Range of the *Globuli*.

XV.
How Cats
and Owls
see by night.

'Tis commonly believed that some *Animals* do emit *Light* from their *Eyes*, and thereby see in the dark, as *Cats*, *Owls*, *Dogs*, and other *Creatures* that hunt their *Prey* at *Night*, avoid dangers, and search out hidden things.

But for all this is so confidently asserted, I question not but that it will be found otherwise. For if any *Light* did proceed from the *Eye*, the same might be perceived by others, or might be concentrated in a *Burning Glass*, which could never yet be proved by any *Experiment*. We are therefore to conclude, that the foresaid *Animals*, do only see by that *Action* which proceeds from the objects. For there is always more or less of *Light* in the *Night*; and therefore we see that *Snow* gives some *Light* in the dark, because it reflects the *Rays* of *Light* it hath received, better than other *Bodies*, that are less white than it self. Wherefore *Cats*, *Owls*, and other *Animals* perceive Objects in the *Night*, not because they shed *Light* from their *Eyes*, which is afterward reflected from the *Object* to their *Eyes* again; but because their *Retina* is more accurately framed, and more fit to receive the *Beams* of *Light*, so as that it can be affected by a very weak *Light*. For it is notorious, that the *Apple* of the *Eye* in *Cats* is so straitned in the *Day-light*, especially when the *Sun* shines strong, that it appears scarce so broad as a *Thread*; whereas in the *shadow* it is so enlarged, as to be almost equal to the whole *Eye*.

XVI.
The Rays
of Light do
more easily

The *Rays* of *Light* do more easily pass through *Glass* than *Water*, and through *Water* than *Air*.

The Reason is, because the *Action* of the *Subtil Matter*, wherein the Nature of *Light* doth consist, is more hindered by the *Parts* of the *Air* that are soft and not well knit together, than by those of the *Water*, which do more strongly resist it. For the more firm and solid the parts of any *Pellucid Body* are, so they be small, the more easily do they transmit the *Light*. Hence it is that *Glass* and *Crystal*, because of the firmness of their parts, do the more easily admit the *Beams* of *Light*.

And much the same Reason may be given, why *Paper* besmear'd with *Oyl*, becomes diaphanous; because the *Oyl* entering into the *Pores* of it, which before, by reason of their winding or crookedness, could not transmit the *Rays* of *Light*, it doth smooth them, and change the *Figure* and bigness of them; and by this means causeth a different disposition of the parts of the *Paper*.

Reflected Light is always less bright and shining, than that which is direct, or not reflected. For take the smoothest *Looking-Glass*, and the most perfectly polish'd, whether by Nature or Art, yet will it never be endued with an entire and most absolute continuity of its parts, without any inequality of the *Pores*, roughness or sign of division. Hence it is, that tho' all the *Beams* of *Light* fall upon it, yet some entering into the *Pores*, are swallowed up of them; or if they do reflect from it, because of some inconspicuous inequality of the extream parts, yet are they insensibly dispersed; so that the entire *Light* is never so dully reflected, but that more or less it is lost, and never reaches the *Eye*.

pass
through
Glass, than
the Water.

XVII.
Why Paper
dip't in Oyl
is Transpa-
rent.

XVIII.
Why Reflec-
ted Light
is less
bright, than
that which
is not Re-
flected.

CHAP. IX.

Of Colours.

A *Peacocks Tail*, and the *Feathers* of a *Pigeon* do wonderfully change their *Colours*; as *Lucretius* elegantly expresseth it.

So *Plumes* that grow around the *Pigeons Head*,
Sometimes look brisker with a Deeper Red;
And then in different position seen,
Shew a gay Skie, all intermixt with Green:
And so in *Peacocks Tails*, all fill'd with *Light*,
The Colour varies with the change of sight.

I.
Whether
the Colour
of a Pea-
cock's Tail,
and the
Necks of
Doves be
true Co-
lours.

These *Colours* are caused when the *Peacocks Tails*, and *Necks* of *Pigeons* are turned towards the *Light*; and by reflexion or refraction do send back the said *Rays* to the *Eye*. They are commonly called *appearing Colours* only, and reckon'd amongst those *Images* that deceive us, and whose entire Essence or Nature consists in their appearance, or seeming such. But the reason why they assert this, I cannot apprehend: For if they admit *Colour* to be nothing else, than the *Light* it self, modified in the surface of *Bodies*, why may not they own those *Colours*, which they call *seeming*, to have as truly the Nature of *Colour* as any other? For can the short duration of the Cause, destroy the *Truth* of the *Effect*? Or doth not a *Son* deserve that name, because he dies almost as soon as he is born? Who will affirm, that the *Greenness* of *Grass* or *Herbs*, which for some days only doth delight our *Eyes*, is less a *Colour* than the *Greenness* of an *Emerald*, which continues so much longer?

Y y y y

longer? For by the same *Argument*, the flame of *Lightning* or *Gun-powder* will be no true *Flame*, because of its suddain vanishing and disappearance. For the lasting or continuance of *Colours* imports nothing to their *Truth* and *Reality*; and those which continue only for a moment, are no less *Colours*, than those which lastingly do affect the *Eyes*.

II.
How Co-
lours come
to be vari-
ed.

The Cause therefore of the variation of *Colours* in the *Peacocks Tail*, and the *Necks of Doves*, is the different *Reflexion* and *Refraction* of the *Rays*, made by the thin *Hairs* of their *Feathers*, because of their various admission of the *Luminous Beams*. Thus those *Pictures*, made of *Feathers*, which are brought out of the *East Indies*, according to the variety of their situation, do exhibit a *Violet Colour*, or bright *Blue*, or a curious *Emerald Green*; forasmuch as the soft *Feathers* whereof they do consist, have their *surfaces* so ordered, as diversly to reflect the *Light*.

But this being besides my present scope, I return to prosecute my *Experiments*.

III.
Two Look-
ing-Glasses,
made of
different
Marble, do
differently
reflect the
Image of
the Sun.

Let two *Looking-Glasses* be made, the one of *white*, the other of *black Marble*; that of *white* being exposed to the *Sun's Beams*, will represent to us a more clear and distinct Image of the *Sun*, than that of the *black*, from which only some *weak Rays* will rebound, which being not sufficiently united together, will only produce a confused Image or *Similitude* of the *Object*.

The Reason of this is, because the action of the *Light*, whereby the Parts of the *Subtil Matter*, push'd on by the *Lucid Body*, do tend towards the *Black Marble*, is almost quite extinguish'd or swallowed up by it, so as that very few of the *Rays* are reflected: Whereas the *White* doth altogether remit the *Action of Light*, and almost reflect all the *Beams* that fall upon them. For tho' *White* and *Black Marble*, consist almost of the very same parts, and no difference is discernible between them by sense; yet it is not to be questioned, but that in the *Black* some soft parts are to be found, which swallow up part of the *Beams*, and break the force of them. So that the *Black Marble* differs from the *White*, much alike as a *Pumice-stone*, whose *Pores* are filled with melted *Pitch*, differs from another *Pumice-stone*, whose *Pores* are only filled with *Air*: For as the *Grains of Sand* cast against the latter, would rebound thence, whereas those cast against the other would be deaded; in like manner, all the *Light* which falls upon the *White Marble* is reflected; whereas that which lights on the *Black*, is mostly swallowed up.

iv.
What is the
Cause of
the White-
ness that is
in Bodies.

The same is apparent in other *Bodies*; for if *Water*, for instance, be strongly agitated and shaken together, it becomes of a *White Colour*, and after that the *Bubbles* of the *Froth* are broken, it is *Transparent*; which is a great *Argument*, that the cause of this *Whiteness* is, when the *Light* is wholly and entirely reflected from the small *Bubbles* of the *Froth*, as from so many *Looking-Glasses*. And accordingly the *Black Marble* is like *Hangings*, which upon the casting of a *Ball* against it, doth receive motion, but doth not rebound; whereas the *White* is like a hard *Wall*, which sends it back, and without any motion of its own, doth reflect it.

v.
Why White
Marble is
less suscep-

Hence it is, that if you take 2. *Polish'd* pieces of *Marble*, the one *White*, the other *Black*; and in hot weather expose them to the *Sun-beams* for

some time, you'll find that the *Black* will be very hot, whereas the *White* will, for all that, in a great measure, continue cold. Whereof no other reason can be given, but that the *Black*, because of its many *Cavities*, doth freely admit the *Globuli of Light*; whereas the *White*, because of its closeness, doth reverberate the received *Light*, retaining nothing of it. Accordingly as we daily observe in *whited Rooms*, which do reflect more *Light*, and do, in a manner, send it all back again from them. Hence it is, that when the *Light* of the *Sun* is admitted into a *Darkened Room*, through a little *hole*, if the *Rays* be received upon a *white Paper*, they appear very bright and shining; whereas they shew very weak and faint, when they light upon a *black Body*.

Polish'd Marble is of a blacker Colour, than that which is *Rough*.

The Reason is, because in the *Rough* there be many *Prominences*, which every way reflect the *Light*. For the *Ray* which is reflected from one part of the *Body*, goes one way, and that which is reverberated from another part, another way. But a *Polish'd Body*, forasmuch as it consists only of one continued *Superficies*, therefore it reflects fewer *Rays* to the *Eye*. Moreover, seeing there is no *Body*, in Nature, so *Black*, which doth not consist of many parts, which being separated from the rest, would constitute a *white Body*, as the difference there is between the *Polish'd* and *Rough Marble* doth abundantly testify: We may say that *Polish'd Marble* is most black, because its *white* parts do reflect the *Light* they receive, towards the same part; where if there be never an *Eye* to admit it, it is the same with respect to it, as if the *Light* were quite extinguish'd. But when the *Eye* is placed in that part to which the reflexion tends, it perceives this *Light* in the *Marble*, together with the *Colours* and *Figure* of the *Object*, from whence the *Light* doth proceed; no otherwise than if it did proceed from a *Looking-Glass*.

Now that an absolutely *Polish'd Body* doth only reflect one *Ray* to the same point of the *Eye*, may be thus demonstrated. Let *BF*, be suppos'd to be a perfectly polish'd Plain, and let the *Light* be in the Point *A*, and the *Eye* at *H*, let the reflex *Ray* be *DH*, so as that the *Angles ADB*, and *HDF* be equal; it is evident, that no other *Ray* derived from *A*, will be reflected to *H*, supposing that the surface *BF*, be absolutely smooth and even. For let there be any other *Ray* of incidence, suppose *AC*, I say, that the *Angle ACB*, is greater than the *Angle ADB*; wherefore supposing an equal *Angle of Reflexion ACI*, the reflected *Ray*, *CI*, will never reach to *H*, nor will ever concur with *DH*, but rather fall wider from it, the further it is drawn. And the same must be said of all the other direct incident *Rays* between *B* and *D*. Wherefore there will only one *Ray* be reflected at *H*, viz. *DH*. I have said before, if the *Body* be perfectly smooth, for if it be not, the case will be otherwise, upon the changing of the nature of the Plain.

Some *Bodies* do constantly keep the same Colour, and which way soever they are turned towards the *Light*, do always reflect it after the same manner; so *Coals* always appear *Black*, and common *Snow*, *White*.

ptive of
Heat, than
Black Mar-
ble.

VI.
Polish'd
Marble ap-
pears of a
blackier Co-
lour than
that which
is Rough.

VII.
A perfectly
Polish'd Bo-
dy can only
be seen on
one side.

Figure
13.

VIII.
Some Bodies
retain al-
ways the
same con-
stant Colour,
as Coals,
Snow, &c.

The

The cause of this constant Colour is to be ascribed to the Disposition and Situation of the Parts, which as long as it continues the same in Bodies, they admit the Light at certain Angles, and accordingly reflect it to the Sight. For Charcoal is black, because its surface is rough and uneven, by reason of innumerable furrows and chinks, which choak the Rays of Light, and break their force. Which may be evinced, not only by reason, but by our very Senses. For if a man do gently handle Charcoal, he will be sensible of a kind of Roughness, something like that we feel in a Pumice-stone; which, as I said before, is not capable of being polished. For whilst Wood is burning, much Smoke and Exhalation flies away from it, by the force of the Heat; and therefore the Fire being rarefied between the Cavities of the Wood, doth break its prison and dilate the pores; into which, when the Rays of Light enter, they are there swallowed up and entangled, so that they cannot rebound to the Eye.

But yet we must not imagine with some, that Colours do formally exist in Bodies, but effectively only, inasmuch as they produce them in the Eye, by means of a certain disposition of the Insensible parts, and the Reflexion of the Light: In the same manner as a Needle, which is destitute of all pain, yet being thrust into the Skin, doth by its motion, figure and hardness, produce Pain there.

Thus all Sulphurous matters exhibit a Red Colour: As when the Spirit of Turpentine being digested with the Calx of Lead, yields a deep Red; and the Spirit of Soot mixt with any acid Liquor, or Common water, affords a white or milky Colour. Thus the Light proceeding from 2 Lanthorns, the one of red Glass, the other of blew, being receiv'd on a Paper, will represent there a Purple Colour. All which Instances manifestly evince, that Colour is not inherent or fixed in a Body, but only a result of the Reflexion of Light.

Glass, when it is whole and extended in Panes, is transparent, that is, of no Colour, or if it have any, it is rather of a black than white Colour; but when beaten in a Mortar, it appears white.

The Reason is, because beaten Glass hath many Surfaces, which every one of them do receive the Light and reflect it again, as so many Looking-Glasses. For seeing that Glass is destitute of all Moisture, and that all its parts are of a round figure, as may be experienc'd by the help of a Microscope, one of them reflects one part of the Light, and the other, another, and so on, so that they reflect the whole Light, and that after the very same manner as they have received it. Hence it is that White Bodies are, of all others, the least opaque; because they reflect the Rays of Light from every point of them, and suffer none to be swallowed up of any of their Cavities.

Neither is there any other Cause of the whiteness of Snow, which consisting of Bubbles, doth send the Rays to the Eye, according to the multitude of the Bubbles whereof it is composed. Nor is this contrary to what hath been said before, that from every Bubble, one Ray only is sent to the Eye: For since they are not sensible, neither do they hinder, but that abundance of continual Rays may be directed to the Eye. Hence it is that Snow, which is nothing else but Frozen-water, yet doth

appear whiter than Ice; for seeing that the surface of Ice is not so much curled, as the surface of Snow, and that there are many Deconvexities or Roundings in Snow, from whence the Light may be reflected, which are not to be found in Ice; it cannot be, but that Snow must appear whiter than Ice. And for the same Reason it is, that water beaten together, turns to froth, by its being divided into round and small parts: For if the Bubbles, whereof the Froth consists, be so great, they will cease to yield a white Colour. Thus likewise the Whites of Eggs, when beaten, lose their Transparency, and become white; and Crystalline Glass, heated in a strong Fire, and quenched with water, is resolved into so many flits, that it appears altogether white.

Rotten Wood, as also stinking Fish, are of a kind of whitish Colour, when exposed to the Air; but when put into the Pneumatick Engin, upon the extraction of the Air, do lose all Colour.

The Reason is, because the particles of putrefying Bodies, are agitated in such a manner as is necessary, for the causing of the Sense of Light. For the Corruption of any Body is caused by the motion of its parts, whereof some fly away and are separated from the rest; and those that remain, impart their Vibration or Motion to the inter-jacent Air, and by this means do afford a weak Light to it. But seeing that all the Air is supposed to be extracted out of the Pneumatick Engin, it needs not seem strange to us, if the Fish which shined before, doth no longer shed any Light. For the Air, by its Elastic virtue, doth assist the agitation of the Light, and where its motion is stronger, there the Light also is increased.

Thus FRACASI is of Opinion, that the Reason why the Blood appears of a darker Colour at the bottom of a Porringer, than at the top, is not because, as the common Opinion is, that part is the more Melancholy portion of the Blood; but because the lower part of the Blood is not so much exposed to the Air, and therefore appears less Ruddy and Florid, than that which is on the top.

Why the Blood that is in the Arteries and Veins is Red, appears from what hath been said in my Institution of Philosophy, viz. That the motion of the Globuli of the second Element, which are the Cause of Light, is twofold, the one whereby in a strait Line they are carried to our Eye; the other, whereby they are whirled about their own Centers. So that if they be whirl'd about much slower, than they move in a right Line, then the Body whence they are reflected will appear blew to us; but if they be whirl'd about much swifter, then it will seem red. Now no Body can be disposed to make them whirl about more swiftly, but such an one as consists of Branchy parts, and those so thin and near one another, as to have nothing about them, save only the Matter of the first Element, such as the Parts of Blood are. For the Globuli of the second Element meeting with the Matter of the first Element in the surface of the Blood; which Matter doth without ceasing obliquely pass through the same, and that with great swiftness, out of one pore into another, so as to be moved after a different manner from the Globuli; they are forced to whirl about their own Centers, by the Matter of the first Element, and

XII.
Fishes
tending to
putrefacti-
on, do yield
no Colour
at all in
the Pneu-
matick
Engin.

XIII.
Why the
lower part
of the
Blood in a
Porringer
appears of
a darker
Colour,
than that
at the top.

XIV.
Why the
Blood that
is contain'd
in the Ar-
teries and
Veins, is
Red.

IX.
In what
sense it is
that Co-
lours are
said to be
in Bodies.

X.
Why beaten
Glass seems
to be white.

XI.
What is
the Cause
of the
Whiteness
in Snow.

and that more swiftly than they could be forced by any other Cause, because the *first Element* exceeds all other *Bodies* in swiftness.

XV. And the same is the Reason, why *Red-hot-Iron* and *Burning-Coals* are red; even because very many of their *pores* are fill'd only with the *first Element*. But because the said *pores* are not so narrow as those of the *Blood*, and that there is much of the *first Element* in them, to produce *Light*, hence it is that their *Redness* differs from the *Redness* of the *Blood*.

XVI. Very Famous and Credible persons give us an account of a certain *blind Organist*, who lived near *Utrecht* upon the *Maes*, who had such an exactness of *Feeling*, that by the touch of his *Hand* only, he was able to distinguish several *Colours*.

It will not be very difficult to assign the Reason of this wonderful Effect, if we consider that the interruption of parts in *Bodies*, doth very much conduce to the production of *Colours*; forasmuch as it is evident, that most *Colours* proceed from the roughness of *Bodies*, and the figure, order, situation and motion of the parts. As is evident in *red Marble*, the polished part whereof is very different in *Colour*, from that which is *rough*. So likewise we may perceive by a *Microscope*, that the *yellow* parts in a piece of *Silk*, are very different from the *blew*. Forasmuch therefore as there is so great a variety of Parts in *Colour'd Bodies*, which may admit a Reflexion or Refraction of *Rays*, we may conclude, that it seems probable enough that the forefaid *blind Man* might have such a quick *Touch*, as to be able to distinguish colour'd *Objects* by the roughness or unevenness of their parts.

XVII. Several *Bodies* mingled together obtain a different *Colour* from what they had before: Thus *Oil of Anniseed*, mixed with *Oil of Vitriol*, turns red; *Spirit of Turpentine* poured upon *Sugar of Lead*, or *calcin'd Lead*, produceth a red *Tincture*; and the *yellow Gall* in *Animal Bodies*, according to the Opinion of *Physicians*, is the product of the mixture of adust *Sulphur* and *Salt*.

This production of different *Colours* is caused by the inward disposition of the parts of *Bodies*. For it is certain, that from the alteration of the least parts of one *Body*, a different *Colour* must arise; as appears evidently to the *Eye* in *Herbs* that are beaten in a *Mortar*. For the temperament and ranging of the *Parts*, is, as it were, the first Rudiment of *Colours*, which upon the appearance of *Light*, and its being diversly reflected and refracted from those particles, doth super-add the last and most absolute perfection to *Colours*. Thus the *Stone Magnesia*, which for colour and hardness doth resemble a *Load-Stone*, being in a certain proportion added to *Glass*, renders it perspicuous, and quits it of its *green Colour*; but if more than is necessary be added to it, it makes it black. Thus an *Apple cut in two*, at first appears white, then turns yellow, and last of all black, according as the surface of it becomes differently disposed, by the drying of its parts.

XVIII. The transparent and clear Infusion of *Galls* being mixed with a Solution of *Vitriol*, makes *Ink*; to which if you afterwards add *Spirit of Vitriol*, or *Aqua-fortis*, the black *Ink* will become transparent again, as *Spring-water*; and if you drop

some Drops of *Oil of Tartar* into this clear *Liquor*, it will be turned again into *Ink*. The *blew Tincture of Violets*, infused into the *Oil of Vitriol*, becomes of a purple *Colour*; to which if you add a few Drops of *Spirit of Harts-horn*, the purple *Colour* will be changed to a green.

The Reason why 2 clear *Liquors* mingled together make *Ink*, is, because the particles of either of them are brought nearer together, so as to hinder the passage of the *Rays of Light*. And whereas the said *Ink* afterwards, upon the pouring another *Liquor* into it, becomes clear again, the Reason is, because the particles of the new added *Body*, do separate the Parts that before were contiguous, and consequently make an open passage for the *Light*, to pass freely, as before.

The Difference of *Colours* proceeding from the mixture of *Liquors*, is to be fetch'd from the small particles contained within the pores of each *Liquor*, which being changed in situation and position by the *Liquor* that is poured into them, do transmit the *Rays of Light*, variously refract or reflect them, and consequently produce different appearances of *Colours*. For, as was mentioned before, when the *Globuli* have more Right motion than Circular, they afford a *Violet Colour*; if they have more Circular motion than Strait, the *Liquor* appears yellow; but if the *Globuli* have much more Circular motion, than Right motion, they produce a *Red colour'd Liquor*: Again, if the *Aethereal Globuli* have more Right motion, than Circular; but yet less than the *Globuli* of those *Rays* that produce a *Violet Colour*, then they yield a *blew*. And in like manner we are to conclude concerning all other *Colours*, the variety and sudden changes whereof, in *Liquid Bodies*, is chiefly to be attributed to precipitation.

Thus we find, that sharp and acid *Salts* cause a thousand changes in the *Colours* of those *Liquors* with which they are mixed, according to the different Nature of the said *Liquors*. As for Instance, the *Oil of Vitriol* makes a black composition, with the infusion of *Galls*. Common *Brimstone* dissolved in the *Oil of Tartar*, becomes of a fair *Citron colour*. *Spirit of Nitre* turns the Juice of *Herbs* as white as *Milk*. *Spirit of Wine* turns red, when it hath been digested a while with the *Salt of Tartar*. The *Syrup of Violets* turns green, by the mixture of an *Alkali*; and red, by adding an *Acid* to it. *Acids*, or Sowre things destroy *blew Colours*, and *Alkali's* do restore them again. The Infusion of the *Indian Wood*, affords an amber *Colour*, when mingled with *Acids*. And the Solution of Common *Brimstone*, made by an *Alkali*, turns white, by adding an *Acid* to it. All which solely proceeds from those Dispositions which *Acid* and *Alkali Salts* produce in the pores of those *Liquors* to which they are added, which is such, that the *Light* which penetrates them, receives all the Modifications that are necessary for the several *Colours* we find produced by these mixtures.

Most *Powders* are white, if they be dry and beaten, or ground very small.

Because all those small *Bodies* into which the *Powder* is resolved, are Spherical, and like so many *Globuli*, which reflect all the *Rays of Light* to one point. And if it happen that the grains of any *Powder*

XIX. The Cause of the variety of *Colours*, proceeding from the mixture of *Liquors*.

XX. Sharp and Sowre Salts alter the *Colours* of *Bodies*.

XXI. Why *Powders* are generally white.

Powder do terminate in a *Point* or *Angle*; then they do not give a *white* Colour, but some other. For I have often taken notice, by making use of a good *Microscope*, that the *grains* of *white Sand* are either *Round*, or approaching to a *Conical figure*, that is, of a smooth crooked surface; but that the *grains* of *Sand* of any Colour, were *Rough* and furnished with many prominent *Angles*.

XXII. *Why Veal, after it is dress'd by the Fire, looks white.*
Veal, and *Hens* or *Capons*, are of a *white* Colour, when boiled or roasted, and lose the *red* Colour they had, when they were yet *Raw*.

The Reason is, because the *Heat* hath chas'd away the *Moisture* that was before in the *Veal*, as well as in the flesh of *Hens*, &c. for *moisture* shut up in the *pores* of *Bodies*, is a hindrance to *Whiteness*, as is evident in all dry things, which by the separation of their *moisture* become *white*; because *Moisture* doth not permit so much fraction as the *Air* doth; and yet so much is necessary to cause *Reflexion*. Hence it is, that a *Body* that is newly whited with *Quick-lime*, appears at first to be of a *dusky* Colour, and afterwards, in success of time, becomes *white*; because at first it hath much *moisture* mixed with it; which being exhal'd into the *Air*, and the *Quick-lime* dried, yields a *white* Colour.

XXIII. *Cloth exposed to the Sun changes its Colour.*
 Colours wherewith *Cloth* or *Silks* are died, do soon lose their *Lustre*, by being long exposed to the *Sun*, and degenerate into a faint *Liveless* Colour.

This proceeds from a twofold Cause: *First*, Because many of the *particles* of *Dyed Bodies*, which compose the *Tincture* are exhaled, by the *Sun's* agitation. *Secondly*, Because many little *Bodies*, that wander up and down the *Air*, do thrust themselves into the *pores* of the *Cloth*, which by covering its *Lustre*, efface its former Colour. Wherefore they that deal in *Cloaths*, have a care that they be not long exposed to the *Air*, but keep them shut up.

XXIV. *The Spirit of Vitriol is hurtful to the Teeth.*
 Some make use of the *Spirit of Vitriol*, to whiten their *Teeth*.

But this may well be reckon'd amongst *Vulgar Errors*, since it is notorious, that the *Spirit of Vitriol*, in conjunction with an *Alkali*, doth produce a *yellow*: And forasmuch as something of an *Alkalous Nature* is continually transfused from the *Gums* and other parts of the *Body*, it must follow that the *Spirit of Vitriol* being commixt with such a *Salt*, must rather make them of a *yellow* Colour, than any whit conduce to the whitening of them.

XXV. *Sugar, and hot Meat, blacken the Teeth.*
 It is observed, that the frequent use of *Sugar*, and too hot *Meat*, does blacken the *Teeth*; because *Sugar* abounds with *Volatile Salt*, whose sharp-pointed *particles* do *Worm-eat* the substance of the *Teeth*, and make great *pores* in them; wherein the *Lucid Rays* being suffocated, do produce a *black* Colour. And the same effect is also caused by hot *Meat*, the agitation of whose *particles* do likewise bore many *Cavities* in the *Teeth*.

XXVI. *What is the cause of those various Colours which appear in a long*
 A *Glass Vessel* of a long figure, like a *Gourd* or *Cucurbit*, being fill'd with *water*, and expos'd to the *Sun-beams*, so as that they may enter obliquely through the narrow *Mouth*, at the upper part of the *Vessel*; these *Sun-beams* falling upon a *white Paper*, or piece of *Linnen*, will represent various Colours. For the uppermost Colour will be *Red*,

the Lowermost *Blew*, and the Middlemost *Whitish*.

The Reason of this appearance, is to be fetch'd from the various Transmission of the *Rays*: For Experience tells us, that *Rays* passing obliquely or slantingly through a *Hole*, must needs be refracted, which *Refraction* is the cause of all this variety of Colours; forasmuch as the *parts* of the *subtil matter*, which we conceive as so many little round *Bodies*, which role continually through the *pores* of *Earthly Bodies*, are variously moved, according to the diversity of the Causes which determine their motion. So as that the Colour, which is represented at the upper part of the *Glass*, is *red*; because the *Heavenly Globuli*, which transmit the Action of the *Light*, are much more swiftly whirl'd round, than they tend in a *Right line*. But a *blue* Colour is represented in the lower part, because the same *Globuli* are more slowly in their circular motion, than in their direct and strait tendency. Because there is supposed to be a Cause which hinders their Circumvolution. But in the Midst a *white* Colour is seen, because the *Heavenly Matter* there hath an equal proportion of Circumrotation and Proceffion. For those *Bodies* are called *White*, in which the circular motion of the *Globuli* is equal to their tendency in *Right lines*. So that the whole difference of Colours doth only depend on the different proportion of these motions of the *Celestial Matter*. As hath been more at large declared in my *Institution of Philosophy*.

XXVII. *Of a Wood brought from Mexico, which gives a various colour to Water.*
 ATHANASIUS KIRCHERUS, in his *Book of the Art of Light and Darkness*, tells us of a sort of *Wood* growing about *Mexico*, which the *Inhabitants* call *Coati*, which communicates a great variety of Colours to *water*. For if a *Vessel* be made of the same, and filled with the clearest *water*, it after a little time standing turns the *water* into a *blue* Colour, which continues in the *water* as long as it stands in the said *Vessel*; but being poured out into a *Crystalline Bottle*, and expos'd to a full *Light*, it recovers its former perspicuity; but if it be brought into the *shade*, it turns *green*, and if it be brought into a yet darker *shade*, it appears *red*, and that very deep, as approaching somewhat to *blackness*.

The *water* put into a *Vessel* of this *Wood*, appears first to be of a *blue* Colour, because it cannot be question'd, but that the infused *Liquor* doth enter the *pores* of the *Wood*, and fetcheth out many of the small *particles* thereof; which being mixed with the *moisture*, are the cause why the *Rays of Light* are in that manner refracted and reflected, as is necessary for the production of a *blue* Colour. Again, when this *water* is pour'd into a *Glass Bottle*, it appears *clear* and transparent, because of the full brightness of the *Sun*, to which it is exposed. For tho' the *particles*, which the *water* had fetched out of the *wood*, did reflect or refract some of the *beams*; yet now the prevailing power of the *Light* doth efface that disposition of *Parts*, and makes its way without any let or hindrance through the *water*. Thus we find by daily Experience, that the *Sun* shining through a *Glass Prism*, doth not exhibit the Colours of the *Rainbow*, tho' they be exactly represented on a piece of *Paper* that receives the said *Rays*. Then afterwards this *Bottle* being removed

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removed out of this great and strong *Light*, into a more moderate or shaded *Light*, is turned into a curious and pleasant *Green*; because from the brightness of the *Sun*, which affords abundance of *Light*, the *blue Colour*, which the *Wooden Vessel* did produce, is changed into a *green*, which is compounded of a *blue* and a *yellow*. And last of all, when the *Bottle* is brought into a more shady place, the *water* appears of a deep or *dark red*; because the *Redness* is weakened by the decrease of the *Light*, and is changed into a kind of *Rusty Colour*.

XXVIII.
Brazile
Wood communicates
a Red tincture to
water.

In like manner we know, that *Brazile Wood* communicates a *red Colour* to the *water* wherein it is boiled; which being put into a *Drinking-glass*, if a little distill'd *Vinegar* be added to it, it immediately is turned into the colour of *Straw* or *Amber*: From which sudden change of *Colours*, we have good reason to conclude, that all *Colours* do arise from the various texture of the *parts*, and the different reflexion of the *Light*.

XXIX.
Nephritick
Wood yields
a Golden,
blue, and
yellow
Colour.

There is also another kind of *Wood*, which hath taken its name of *Nephritick Wood*, from the great use it is of in curing the *Gravel*, the parts whereof being infused in *water*, and put into a *Glass Vial*, do after a few hours tinge the *water* of a *Golden Colour* if the *Vial* be placed between the *Eye* and the *Window*; but if the *Eye* be placed between the *Window* and the *Vial*, it will appear of a *blue Colour*. For when the *Rays of Light* do enter into the *Liquor*, they become tinged with a *yellow Colour*; but the same represent a *blue*, when the *Rays* reflect from the *Vial*. And if you pour an *Acid Liquor* upon it, then the *blue Colour* will vanish, and the whole *Liquor* will appear of a *Gold Colour*.

The Reason of this is probably no other, than that of the foregoing: For it is evident, that this *Wood* doth consist of *Tinging particles*, which are easily resolved in the *water*, and so far seem to be much of the Nature of *Salt*; which *particles* entering the *pores* of the *Water* do so refract the *Rays*, that they appear tinged with a *Gold Colour*. And if you admit the *Light* of the *Sun* through some *Hole*, into a *dark Room*, and place the *Vial* full of the Infusion of this *Nephritick Wood*, partly within the *Cone of Light*, and partly without it, you will observe a vast variety of *Colours*, caused by the various degrees of the *Refraction* of the *Light*. Now the Reason why, after that the *blue Colour* hath been extinguish'd by an *Acid Liquor*, it should be restored by the Affusion of *Oil of Tartar*, or a *Sulphureous Salt*; and on the contrary why, when the *Gold Colour* is vanished, it is restored by the addition of an *Acid Liquor*, is, because *Acid Salts* do cut and slash the tinging *particles* into lesser divisions, or at least precipitate them, and so make the *Colour* to appear more weak and dilute.

CHAP. X.

Of Occult Qualities.

I.
What Occult Qualities are.

Occult Qualities, are by the *Peripaticks* called *Hidden Powers*, by which *Natural things* do act or suffer any thing, and whereof no prior Reason can be assigned, as immediately proceeding from the *substantial Forms* of things. But our

Modern Philosophers are at a loss about what the *ARISTOTELEANS* means by all this *Gibberish*, who denying all *substantial Forms*, despair of ever knowing what these *Occult Qualities* are, which are the immediate products of them. Wherefore the abstruseness of some *Qualities* doth seem only to depend on the different *Hypotheses* of *Natural Principles*; so as that to those who follow the *Peripatetick Hypothesis*, the *Ebbing* and *Flowing* of the *Sea*, and the *Conjunction* of the *Iron* with the *Load-stone*, appear to be abstruse and hidden *Qualities*; whereas, according to the *Principles of Corpuscular Philosophy* they are most clear and evident effects.

A *Sponge* is commonly supposed to attract *water*, and to draw it upwards.

If we warily consider the thing, we shall find that a *Sponge* is very improperly said to attract *water*; whereas on the contrary, the *water* doth rather mount upwards to the *Sponge*, and intrude it self into its *pores*. For as soon as the *Sponge* toucheth the *water*, it somewhat presseth the same, and makes the pressed part of the *water* to mount up, and enter into the *pores* of the *Sponge*, as is evident in a *writing Pen*, which no sooner toucheth the *Ink*, but it mounteth up into the *Pen* by means of the *Slit* of it. For if the *Point* of a *Pen* without a *Slit* be applied to the *Ink*, no part of the *Liquor* will ascend; or if any part of it stick to the *Quill*, it immediately drops down. The mounting up therefore of the *Water* is caused by the pressure of the *Sponge*, whereby the *Air* is thrust out of its place; which *Air* afterwards pushing against the *surface* of the *Water*, drives it upwards, and by some Force makes it to enter the *Body* that lies upon it.

New Bread put into *Wine*, or any other *Liquor*, will draw up the same 2 or 3 *Fingers* breadth high, and contrary to the *Laws of Nature*, without any Pressure, operates at a distance.

The *Wine* enters into the Cavities of the *Bread*, because they are bigger than is necessary, for admitting the *parts* of the *Air* only; and therefore the *parts* of the *Air* that are shut up in them, are on every side surrounded with the *Subtil Matter*, which doth more swiftly agitate them, than they would be moved elsewhere, in case they continued entangled amongst themselves. And so far as all *Bodies*, which move in places that are too narrow for them, do strive to get out of them; it accordingly happens, that whilst the *parts* of the *Air* do go forth from the *pores* of the *surface* of the *Liquor*, that toucheth it, the *parts* of the *Water*, or any other *Liquor*, do immediately follow it, and possess themselves of the relinquish'd place. And because also the *parts* of the *Liquor* do better fill the Cavities of the *Bread*, they are not so swiftly agitated in them, as the *parts* of the *Air*; and therefore do not endeavour to quit the same, except only in order to enter the higher *pores* of the *Bread*, and take up the place of the *Air*, which strives to get out of the *Pores* thereof.

For it cannot be question'd, but that the *pores* of *New Bread*, how crooked or winding soever they may be, do much assist the ascent of the *Liquor*: For they are as so many *Pipes*, through which the *water* leisurely passeth, when it is pressed by the external *Air*. Mr. BOYLE hath proved this by a like Experiment: For he

II.
Of the
Common
Opinion,
that a
Sponge
attracts
water.

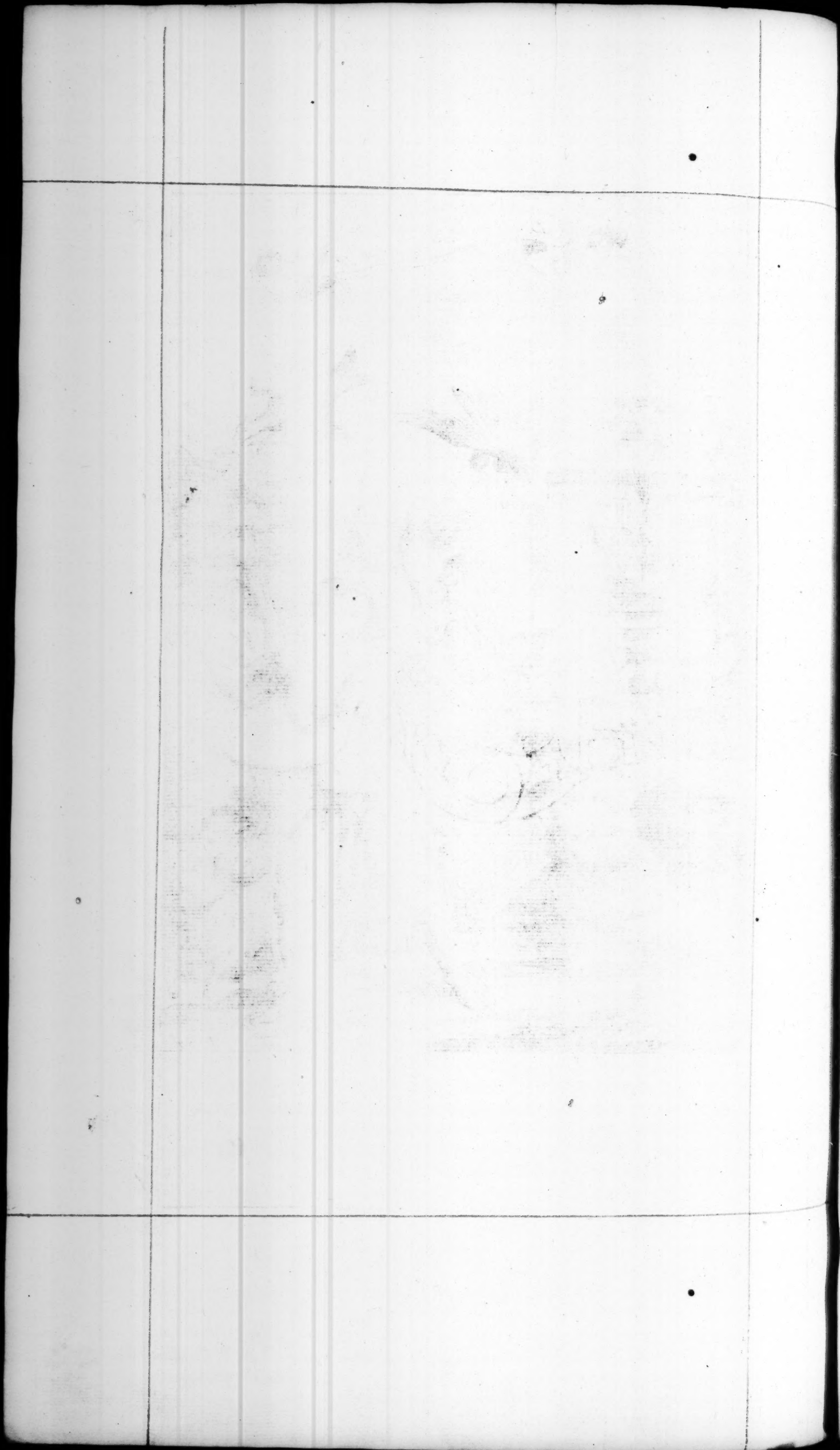
III.
How New
Bread at-
tracts wa-
ter.

IV.
How water
comes to
mount up-
wards in
Calcined
Lead.

took

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took a long *Glass Pipe*, and fill'd it with *Red Lead*, and then put the lower end of the *Pipe* into the *water*, which by degrees mounted up the height of 40 *Fingers* breadths; by means of those *pores*, which, like so many *Pipes*, do convey the *water* upwards.

A *Sheep* trembles at the sight of a *Wolf*; a *Chicken* at the sight of a *Kite*; and the *Pigeon*, dreads the approach of a *Hawk*.

Philosophers commonly attribute these *Aversions* to the mutual hatred that is between these *Creatures*; but without sufficient ground. For a *Wolf* doth not hate a *Sheep*, but is delighted with it, and pursues it as a convenient Good for him. And the same may be said of a *Kite*, that pursues a *Chicken*; and of a *Hawk*, that sets upon a *Dove*. A *Sheep* therefore at the sight of a *Wolf* betakes himself to flight, because it is endued with such a Texture of *Fibres*, that the *Light* reflected from the *Wolfs Body*, doth produce such an affection, upon which the motion of running follows. For there are some *Rays* or *Spirits* which are continually darted from the *Wolfs Body*, which painfully affecting the thin *Fibres* of the *Sheeps Optick Nerves*, do suitably move the *Brain* and the *Spirits* contained therein, and convey them into the *Muscles*, in such a manner, as is necessary to put them upon a flight. For these *Spirits* are of a wonderful force to affect and agitate the *Body* which they push upon, and whose most inward parts they pierce into.

Some *Shades* are commonly accounted to be of a hurtful nature, and to cause either Pain, or some other inconvenience. Thus a *Serpent* flees the shade of an *Ash*. And those who sit down in shady places, are apt to be overtaken with sleep.

These Effects are not caused by the *Shade*, which being somewhat *Privative*, cannot have any positive *Vertue* or Effect; but from the steaming current of particles proceeding from *Bodies*, and more particularly from the neighbouring *Trees*, *Plants*, *Pools*, or any other *Bodies*. And that a person that sits, or lies down in the *Shade*, is very susceptible of these steaming particles that continually flow from *Bodies*, and very like to be affected by them, may be easily conceived, for that in *Summer-time* the *Pores* of the *Body* are more open, and stand ready to receive these outflowing little *Bodies*; and therefore no wonder if they be affected by them.

Thus the Effects do prove that subtil and invisible *Steams* do continually proceed from *Quicksilver*; for which Reason those *Artificers*, who are much conversant about it, are used to keep *Gold* in their *Months*, with which they intercept the noxious *Steams* of the *Quicksilver*, which set themselves about the *Gold*, and cleave to it, and discolour it. Moreover, drops of *Quicksilver* have been found in the *Heads* of these *Artificers*, and in other parts of their *Bodies*. For there are certain pure and subtil *Effluvia* or out-flowings, which proceed almost from all *Bodies*, which retain the Nature and *Vertue* of the *Body* whence they proceed. Neither is it to be doubted, but that *Quicksilver* boil'd in *Water*, doth communicate a *Vertue* to it, of killing *Worms*.

It is a common assertion amongst the *Cabbalists*, that there is a great *Vertue* in *Words*; as by

which, extraordinary Effects may be performed. And I remember to have read somewhere in *Paracelsus*, that upon pronouncing the words *Os, Osa, Serpents* stop their motion, and lie still as if they were dead.

But this is an ungrounded Opinion of the *Cabbalists*, forasmuch as the bare words of the most worthy *Tongue* have no efficacy at all; no more than the *Vertue* of a *Man*, or the signification of some *Holy Thing*, can communicate any *Vertue* to the *Words* pronounced by the one, or importing the other. For tho' it cannot be denied, but that *Orators* and *Poets* do excite *Passions* in the *Minds* of their *Auditors*; yet this is not by any hidden *Vertue* that is in their *Words*, but by the strength of their *Reasons*, and the aptness and *Musical* cadence of their words. Wherefore what *PLINY* tells us in the 2d Chapter of his *Natural History* of the Preservation of the *Fruits* of the *Earth* from harm, by some words pronounced over them, and of the charming of *Serpents*, ought to be lookt upon as *Fiction*. Seeing that words can operate nothing in a natural way, and have nothing of any *Sympathetical Connexion* with intelligences or the *Powers* of *Heaven*.

It is a common Story, that a *Nose* cut out of the *Flesh* of another *Man*, upon the death of him from whom it was taken, corrupts and rots as the *Body* of the dead *Person* doth. And the same is said of the effect of the biting of a *Mad Dog*, which continues till the *Death* of the *Dog*, and then ceaseth.

No sufficient Reason can be given to verifie these Effects; and therefore I suppose that these things are reported by *Authors* without sufficient faithfulness; or if any such thing ever hapned, that it was an effect of chance, and not of any *Physical Causality*.

It is also believed by many, that wounds at any distance may be healed by the *Sympathetical Powder*, by applying the *Powder* to the *Weapon* that made the *Wound*, or to a *Rag* that hath any of the *Blood* of the *Wound* upon it.

But tho' many great *Authors* maintain this for a truth, yet I am not easily persuaded to confide therein. For we do not find in calcined *Vitriol*, which is the Basis of that *Powder*, any thing conducive to the healing of *Wounds*, besides an adstringent *Vertue*, which is very proper to stop *Blood*, and to close and heal a *Wound*. And tho' the *Spirits* proceeding from the *Vitriol*, may be supposed to exert some of their efficacy at a small distance, yet is it not certain, that the *Power* thereof can be conveyed so far as is reported. Neither will the instances that are brought to prove this effect, be of any great weight with those who consider how apt the *Minds* of *Men* are to believe any stories, and how many do seem to take delight in being imposed upon, rather than to be lookt upon as incredulous. So that it seems that these *Cures* ought rather to be attributed to the cleanness of the *Wounds*; since in the *Sympathetical Cure*, charge is always given to wash them with *Urin*, which is endued with an absterfve *Power*, by reason of the *Salts* that is contained therein. And this is no more than the *Dogs* themselves do, who are used to cure their wounds by licking them.

But

V.
A Sheep
flees from a
Wolf, a
Chicken from
a Kite, and
a Pigeon
from a
Hawk.

VI.
Whether
any shade
can be
hurtful to
the Body.

VII.
How
Quicksilver
kills
Worms.

VIII.
There is no
vertue in
bare words.

IX.
That a Nose
cut out of
another
mans flesh,
doth rot
or per-
ish upon
the death
of that
man.

X.
Whether
Wounds
at a dis-
tance are
curable by
the Sympa-
thetical
Powder.

XI.
By what
means some
may be cu-
red by the
Sympathe-
tick Pow-
der.

But if *wounds*, at any time, have been cured with this *Powder*, the same must be performed by the *Effluvia* of little *Bodies*: Which tho' not always, yet very frequently retain the nature of those *Bodies* from whence they stream forth, and transmit the same to a vast distance; and by this means the *particles* proceeding from one *Body*, entering the *pores* of others, may there produce the same effect, and move the *Senses* much in the same manner as the said *Bodies* themselves would do by *Corporal Contact*.

XII.
Whence it
is that
that Twins
are touched
with the
same affe-
ctions.

There is a great *Sympathy* observed between *Twins*; so that if one of them chance to be *sick* of any *disease*, the other is frequently seized with the same.

The Reason whereof is, because they both have the same *Texture* of their *Fibres*, and the same *Temperament* of *Humours*; so that if it happen, that if by any *distemper* of the *Air*, or by any hurtful *Meat* or *Drink*, the one of them falls *sick*, it cannot well be otherwise, but that the same effect must happen to the other, because of the great conformity of their *Frame* and *Temper*. And therefore it is that they are subject to the same motions of *Passions*; so that what produceth loathing in one, will effect it in the other; and whatsoever is desired by one, will also be desired by the other; because a like *Texture* receives the same affection from one and the same *Object*, and consequently stirs up the same *Appetite* and *Passion*.

XIII.
How some
Old Witches
men be-
witch little
Children.

It is commonly said, that some *Old Women* bewitch *Infants*.

Which may be, because these *Old Women*, by the strength of their *Imagination*, intending their *Nerves* and *Muscles*, may dart forth from their *Eyes* some noxious *Spirits*, whereby the tender and easily susceptible *Body* of the *Infant* may be greatly prejudiced, especially if the *Infant* be near to the *Woman*. For *bewitching*, as *PLINY* tells us, proceeds from the *Spirits* of the *Witch*, entering through the *Eyes* of the *Bewitched*, into their very *Heart*. Indeed it seems probable enough, that by this darting forth of *Spirits*, much mischief may be done; since it is notorious, that a *Woman* that hath *Thorns* upon her, doth produce *Spots* and *Stains* in a *Looking-Glass*: And that one who *Coughs*, stirs up *Coughing* in others; and one that *Yawns*, a *Yawning* in him that sees him.

XIV.
Who are
most ob-
noxious to
Witch-
craft.

Whence we may understand the Reason, why all are not equally obnoxious to *Witchcraft* or *Fascination*, but only *Infants* and *Youth*, and others who have their *Pores* more open; and therefore are liable to suffer from the incursions of the *Spirits* and *effluvia* proceeding from others: Especially if the *imagination* of the *Witch* be heightened by *Love* or *Hatred*; because in this case they attack the party *bewitched* with greater force and violence. Wherefore care ought to be taken to keep little *Children* at a distance, and out of the sight of such persons.

XV.
How a Scor-
pion appli-
ed to the
place stung
by him,
draws out
the Poison.

A *Spider* or *Scorpion* that hath bit or stung a person, being bruised, and applied to the part affected, draws out the *poison*.

The Reason is, because the substance of a *Spider* or *Scorpion* is like a *Sponge*; which, whilst the parts that are sever'd by the contusion, shrink by means of the *Nerves*, do take up the adhering

venom, and draw away that which is got in. For this is effected much in the same manner, as *Oyl* is washed out of a *Cloath* by means of *Soap*; for as the *particles* of *Oyl* which are got into the *Cloath*, do easily embrace those of the *Soap*, as being of a like nature, and are carried away with them: So the *particles* of the *Poison* sticking to the *wound*, do easily join themselves with those that are found in the bruised *Animal* applied to it, and by this means the *wound* is freed of them.

KIRCHER tells us, that in *China* there be many *Serpents*, which are called by the *Portuguese* *Har-bearers*, because they have a *Skin* that starts up on their *Heads*, not much unlike a *Hat*, in which little *stones* are found, which being reduced to *Powder*, and mixed with *Terra Sigillata*, and applied to a *poisonous wound*, stick fast to it and draw out all the *Poison*, and then fall off from the *wound* of themselves, which are afterward washed clean in *Milk*, in order to be used again as before. For indeed most *poisons* are better overcome by *Alexipharmacs*, than by *Vomits* or *Purges*.

It is commonly believed, that a *Man* who is seen of a *Wolf* before he sees him, grows *dumb*, and is unable to utter a *word*, or make the least noise.

Tho' this be an old Story, yet there appears no ground at all for it: Seeing that Experience teacheth, that whether a *Wolf* see a *Man* first, or whether a *Man* see the *Wolf*, the same commotion or disturbance follows. I my self have very often lookt upon *Wolves*, yet never perceived thereby any *Hoarseness*, or the least defect in my *Voice*; but on the contrary, have many times by my shouting, made them run away. But how does it come to pass then, that some persons at the sight of a *Wolf* do contract a *Hoarseness*, and become *Dumb* of a sudden? Why this proceeds only from *Fear*, when the great concern they either have for their own *lives*, or for the safety of their *Company*, puts them into a sudden consternation; for then endeavouring suddenly to cry out for help, they hurt their *Lungs* by the great force put upon them, and the *Wind Pipe* by fetching in of too much breath, becomes, as it were, choaked. To which may be added, that the *Muscles* of the *Tongue* being slackned, by the great defect of *Spirits*, cannot readily be made use of, for the forming of the *voice*. So that by the failing of all these Instruments, it cannot be otherwise but that a *Hoarseness* must be caused, and the *Tongue* disabled from uttering an articulate sound.

Some *Plants* have an *Antipathy* against each other; as the *Oak* and the *Olive Tree*, *Cabbage* and *Rue*, *Fern* and *Reed*, which cannot endure the neighbouring of each other, nor can touch one another without some prejudice.

The Reason of this *hatred* is, because these *Plants* are desirous of one and the same *Alimental Juice*; and therefore the stronger of them doth draw all that juice to it self, and by this means robs the weaker of its necessary *food*, which must needs hinder it from growing and thriving as otherwise it would. Or else we may say that *Plants* set near one another, may hinder each others growth, in that the emanations or *effluvia* which

XVI.
Whence it
is that
some Stones
perform the
like effects.

XVII.
Whether
a Wolf
causeth a
Hoarseness
in those
whom he
sees first.

XVIII.
What is
the Reason
of the An-
tipathy
which is
found
amongst
Plants.

which proceed from their *Roots*, may be noxious to each other. For the *Olive Tree* communicates such a bitterness to the ground round about it, that it spoils the *Cabbage* and *Lettice* that grows near it. And *Fern* hinders the growth of *Reeds* by the steams proceeding from it, which obstructs their *Pores*, and disturbs the *Texture* of their *Fibres*.

The *Heliotrope* or *Sun-flowers*, always turns it self towards the *Sun*, and doth so follow its motion, as to face it continually. *Theophrastus* makes mention of some of these *Heliotropick* Plants, growing about the *River Euphrates*, which at the going down of the *Sun*, do so drop their *Heads* and *Flowers* into the *River*, that they cannot be reached with the *Hand*; but as soon as the *Sun* riseth, lift them up again to their former height.

This, I suppose happens, because that *Plant* abounds with much and gross moisture, which being agitated by the *Beams* of the *Sun*, and thereby rarefied, cannot be contained within the same bounds, and therefore strives to make its way through the most open *Pores*, that is, those which are over against the *Sun*: and forasmuch as the *Neck* of this *Plant* is very pliable, the agitated moisture which breaks forth from it in the finest *Threads*, turns it self that way towards which the particles of the moisture tend. The extraordinary moisture of this *Flower* may be confirmed from that *Dew* which lies upon the midst of it, when the *Sun* is at the highest and hottest; which cannot be said to be the remainders of the morning *Dew*; forasmuch as that vanisheth a few hours after the *Sun* Rising; and therefore must be that *humour*, which upon the presence of the *Sun*, doth flow from its *Stalk*, and is carried up to the *Flower*.

In like manner a reason also may be given of that admirable *Dial*, invented by *F. Linus* at *Liege*, whereby a little *Ball*, swimming upon the *water*, did shew the *hours*, and exactly imitate the motion of *Heaven*, after the Example of *KIRCHER*, who having put some *Seeds* of the *Sun-flower* into a piece of *Cork*, found that they turned the *Cork* towards the *Sun*, and that by fixing a hand to it, they exactly pointed out the *hours* placed round the inside of the *Vessel*. For seeing that the *Sun-flower* is turned towards the *Sun*, not only *Eastward*, but *Westward* also, it must needs point to the *hours* noted on the sides of the *Vessel*.

The *Bones* of *Animals* are filled with *Marrow* at the full *Moon*; and *Crabs* at the same time do more abound with *flesh*; whereas in the wane of the *Moon* both are decreased.

These Effects, tho' commonly asserted to be so, yet many most exact observers of the works of Nature testify, they could never discern in either of these any such encrease or decrease, but that the *Bones* of *Animals*, as also *Shell-fish* at any time of the *Moon* are promiscuously found either full or empty, or more or less fleshy, according as it may happen from other accidental Causes.

So that if at any time it happen that *Crabs*, *Lobsters* or *Oysters* be found more full of *flesh* at one time than at another; the reason is, because they have then met with more plentiful *Aliment*: For we find that of *Fishes* that are taken at the same time, and in the same place, some are much fuller of *flesh* and fatter than others; and that those *Fish* which are taken out of the *Nets*, as soon as they

are caught, are fuller of *flesh*, than those which are left in the *Net* a good while before that they be taken out.

The *Skin* of a *Stag*, if it be put by *Tanners* at the bottom of their *Fat*, and the *Hides* of other *Beasts* laid upon it, as soon as *water* is poured into it, never rests till it have got above them all, at the top of the *Tanning Pit*.

GASSENDUS imputes the cause hereof to the wider cavity of the *Stags Hairs* (for the *Microscope* assures us, that the *Hairs* of *Animals* are all of them so many hollow *Pipes*) which being filled with *Air*, endeavour to get above the *water*, as a *Bladder* full of *Air* doth. He supposeth also, that this is a great help and furtherance to the swiftness of that *Animal*, because the said *Pipes* being dilated by the heat of the motion of the *Stag*, doth much contribute to their *Lightness*: as it is also very probable, that the *Quill* part of the *Feathers* of *Birds* are a great help to their being easily supported in the *Air*.

They who are bit by the *Tarantula*, are so delighted with some certain *Tunes*, as to be thereby stirred up to strong and continual *Dancing*.

The Reason whereof is, because the poison of the *Tarantula* doth alter the Temperament of the *Body*, and particularly so affect the *Organ* of *Hearing*, as to comport with those *Tunes*, wherewith that *Insect* is delighted. For as there are several sorts of these *Tarantulas*, whereof some are affected with these *Tunes*, some with others; so that as the *Piper* or *Fidler* plays these, or the other *Notes*, so these, or other of their *Insects* begin to frisk, and cease as soon as ever the *Tune* is done. Accordingly it seems, that the venom of these *Insects*, being diffused through the *Body* of *Man*, and mingled with the *Spirits*, and afterwards excited by such notes, is moved after the same manner, and also impresseth the same motions on the *Spirits*, which by means of the *Nerves* and *Muscles*, produce a *Dancing*, corresponding with such notes. And this is the Cause of the recovery of him that is bit, because by this quick motion, the poison is disscut and exhaled together with the *Sweat*, provoked on this occasion.

Some *Medicaments* do purge by their smell only; others by being handled, or applied to the *Navel*.

The Reason is, because the odour only of a *Medicament* doth as strongly affect the *Nerves*, as they are affected by it, when taken inwardly; that is, when the *Fibres* or *Strings* of the *Stomach* and *Guts* are twinged and vellicated after the same manner, as they are when the *Medicin* is swallowed down into the *Stomack*. For the parts of *Medicaments* are commonly very small and sharp, hard, swiftly agitated, and very penetrative; so as that by this means they do irritate and excite the *Membranous* and *Nervous* parts of the *Body*, and provoke them to *expulsion*. Whence we may conclude, that almost all the properties and virtues of *Medicaments*, which are commonly added to the *Catalogue* of occult *Qualities*, may be explained and resolved by *mechanical Principles* and *Affections*, whether they produce these effects, by a likeness, analogy and familiarity of Nature, or whether they exert this their efficacy by way of irritation.

XXIII.
Why the
Skin of a
Stag swims
above all
other Skins.

XXIV.
Why Per-
sons bit of
the Taran-
tula, do
skip and
dance.

XXV.
How Medi-
caments do
purge.

XIX.
What the
Reason is
of the Sun-
flower turn-
ing towards
the Sun.

XX.
The Expi-
cation of a
wonderful
Sundial.

XXI.
Whether
the Bones of
Animals,
and Shell-
fish be full-
er at full
Moon, than
in the wane
of it.

XXII.
Why Crabs
and Lob-
sters are
more full of
fish at one
time than
another.

The Third Part

OF THE HISTORY OF NATURE. OF THE WORLD, AND HEAVEN.

CHAP. I.

Of the Beginning of the World.

I.
The Opin-
ion of
Aristotle
and Epi-
curus, con-
cerning
the World's
Original.

THO' we be sufficiently assured by *Revelation*, concerning the *World's Original*; yet it will not be altogether useless, to see what *Reason* can say in the case, and whether by her conduct we may not be able to discover the *Beginning* thereof. ARISTOTLE maintains the *World* to have existed from *Eternity*, in his *VIIIth Book of the Physicks*, and in his *1st of Heaven*, where he endeavours to prove *Motion* to be from *Eternity*, and that no *temporal Principle of Motion* can be admitted. To which he adds also, that it is no way agreeable to the *First Cause*, to be *Idle*; and that therefore we must of necessity own, that there must have been something *moveable* from all *Eternity*. And as for EPICURUS, he makes *Matter* to be *Eternal*, but the *World*, *Temporary*, and proceeding from the fortuitous concurrence of *Atoms*; whereof LUCRETIUS treats in his *4th Book of the Nature of things*.

II.
The Opin-
ion of
Plato.

The chiefest amongst the *Ancients*, that attributed a *Beginning* to the *World*, was the *Divine PLATO*, who tho' he acknowledgeth it to have been begot from *Eternity*, yet asserts it to have proceeded from *GOD* by a kind of *Emanation*, as the *Sun-beams* from the *Sun*. And surely he very well deserv'd his Name, forasmuch as from the *Contemplation of Created Things*, he discovered the *Maker* of them; and from the nature of *Effects*, rais'd himself to a view of the *Efficiency of the Supreme Cause*. But let us hear him discoursing the Point in his *TIMÆUS: The Universe*, saith he, *is seen, felt, and hath a Body; all which things move the Senses, and those things which move the Senses, are known or discerned*

by the Senses. Now it is apparent, that such things as these are of that nature as to be generable and generated; but whatsoever is generated, we assert must be generated by some Cause. It is a thing of difficulty indeed to find out the Maker and Father of this World; and after that you have discovered him, to declare him to the Common People.

Indeed there is nothing in the *Universe*, which doth not preach the *Creatour* of it; nor doth *Nature* represent any thing to the *Eyes of Men*, which doth not speak its *Author*, and excite us to adore and praise him. Who is there, that by the *Disposition of the Parts of the World*, is not forced to own its *Original*, and to confess that it is not *Eternal*? Shall we imagine that all these things, as EPICURUS will have it, were the effect of blind *Chance*, and that it stumbled upon all these curious and beautiful *Effects* we do admire? Were the *Earth*, the *Heavens*, the *Stars* their own *Causes*, and stated in that necessary and conly Order, without the *Deliberation of a Contriver*? What *virtue* or *force* is there in *Atoms*? What *power* in *Matter*, towards the production of a *World*, beautified with such an infinite variety of *Wonders*? Or, if these *Atoms* were the *Framers of the Sun, Earth and Planets*; why did not these blind and stupid *Artificers*, jumble themselves as well into *Cities, Houses, Churches, and Piazza's* for us? Since these are Instances of a more easie and obvious *Artifice*, and such as human *Industry* can furnish.

An *Engin* curiously and accurately wrought, bears the stamp of the *Artificer* upon it, and is an incontestable *Demonstration* of his *Ability and Skill*. But what *Machin* is there in the least degree comparable with this ravishing frame of the *Universe*? In which, nothing is dull or idle; nothing produced at a venture, or in vain. Consider the *Vegetables*, they have all of them their peculiar

virtues.

III.
The Dispo-
sition of
the Parts
of the
World,
proves the
Maker of
it.

IV.
The Fa-
brick of
the World
proclaims
its Maker.





virtues. Take a view of the *Animals*, they have all their particular *Natures*, and several propensities. Mount up to *Heaven*, and there behold the *Stars*, so exquisitely ranged, performing their motions with so much steadiness and equability, and always keeping within the bounds of unchangeable Vicissitudes. No man can be so senseless, saith MERCURIUS TRISMEGISTUS, to affirm, that a *Portraiture* or *Statue*, can be made without a *Painter* or *Statuary*: And will you say, that this Great Work had no Maker? O Blindness beyond compare!

V.
The Parts
of the
World be-
ing Cor-
ruptible,
constitute
the whole
so.

The *Whole* is of the same nature as its *Parts*, as being the result of them, and deriving its distinction from their Diversity. Now nothing is more notorious, than that the *Parts* whereof the *World* is composed, are subject to *Rise* and *Fall*, to *Generation* and *Corruption*. The *Earth* is nothing else, but a great *Theater*, where these *Changes* are continually represented, and which, according to the different Vicissitudes of *Time*, is differently dressed and mark'd. The *Fire* perisheth daily, and that which seems of such insuperable Force, vanisheth in a moment. *Water* is suckt out of dry *Bodies*, and by its motion wherewith it penetrates *Bodies*, becomes turned into *Flowers* and *Grafs*. Nothing in the *World* is of any long continuance; and it is a clear Demonstration, that that had a *beginning* of its being, which is continually hastening to its end.

VI.
An Obje-
ction.

Some endeavour to avoid the dint of this Argument, by saying that *Generation* and *Corruption* are incident indeed to the *Parts* of the *World*; but that nothing hinders, but that the *Whole* may continue for all this for ever; forasmuch as the *Total Sum* continues still the same, and is only changed as to some *Externals*, much in the same manner as *Wax*, by admitting the various impressions of *Seals*, only changeth its figure, still retaining its substance unalter'd.

VII.
Answer.

We readily grant them, that no other Change happens to this *World*, but what is *Accidentary*; yet can it not be concluded from thence, that the *Whole* is capable of being dissolved. For if one or the other Part may perish, why not 20, or 100, or 1000, nay, all of them; since we find various *Destructions* hapning in divers places, and that many things are oft ruin'd in one day, which had continued untoucht for many *Ages*? And tho', it may be, these things may not be very frequent, and have the *Intervals* of many *Years* between them; yet cannot we thence infer, that they can't happen: Seeing that many things throng in upon the *World* at one time, which have been unknown and unheard of for many *Ages*. The Instance of the *Wax* is nothing to the purpose, whose Change is only outward: For the *World* is capable of those *Intestine motions*, which one day or other will be the overthrow of it. Do not we daily see New things start up, and Old things sinking and perishing? We have therefore good reason to conclude, that as we see that *Changes* happen to the *Parts* of the *World*, so the whole is obnoxious to the same alterations and perturbations. Hence LUCAN, in his *First Book*:

One Common Fun'ral-Pile the World shall burn,
Mix Bones with Stars, and all to ruin turn.

But forasmuch as our design here is, to set down an *History* of *Nature*, we will endeavour to derive the *Original* of the *World* from the *Monuments* of the *Ancients*. We have no *History* that gives us any account of things that passed before the *Theban* and *Trojan War*. But if the *World* be *Eternal*, and consequently without all *Beginning*, how could it be that the *Historians* and *Poets* of fore-going *Ages* should not have deliver'd to us the *Deeds* of the *Heroes* of their *Times*, which they achiev'd during such immense *Spaces* of *Time*, or the *Laws* enacted by *Legislators*? Wherefore since nothing of these is any where to be found, it affords us a tacit Argument, that the *World* was *Created*, and had its *beginning* not long before those *Times*.

Besides, who will say, that the *World* hath been from *Eternity*, when as, besides the *Testimony* of *Historians*, the *Improvement* and *Invention* of *Things* and *Arts*, shew it to be of no over long standing? For the account which the *Ancients* give us of *Men*, is, that they liv'd after a *Barbarous manner*, not much different from that of *Beasts*; and that they did not Feed, as we do now-a-days, but maintain'd their *Lives* in the open *Woods* and *Fields*, with *Acorns* and *Berries*, as MACROBIUS tells us; and that it was not till long after, that they began to Till the *Ground*. Besides, is not this a strong Argument for the proof of the *Non-Eternity* of the *World*, that the *Greek History* it self doth not make mention of any Matter of Fact, beyond the Space of 2000 *Years*, there being nothing memorable related in *History* before NINUS, who was the Father of SEMIRAMIS. Now if the *World* was from *Eternity*, why were not all things highly improved, during that vast Vicissitude of innumerable *Ages*? Or, how comes it to pass, that New things are yet Invented? All these things are strong Arguments against the *Eternity* of the *World*, and give us great Reason to suppose, that as the *World* had its *Beginning*; so all things in successive *Years* were Invented, Cultivated, and Improved.

Neither are we pinch'd by that Objection which is commonly made by the *Platonists*, that nothing hinders, but that the *World* might have been produc'd from *Eternity*; seeing it is not repugnant for some Effects to be coexistent with the Principle of their *Emanation*. For the *Question* here is not, Whether the *World* might not have been *Eternal*, and Coexistent with its *Creator*; but whether it be really so? Since it is evident, that GOD doth not act of *Necessity*, but freely and spontaneously, after the same manner as a *Workman* is the Cause of his *Work*. For tho' the *Idea* of the *World* be granted to be from *Eternity* in the Mind of GOD; yet doth it not follow from thence, that the *Work* made by it is *Eternal* also, except we should affirm, that the thing conceived is inseparable from the perception of it; and that a *House* is built, as soon as the *Architect* hath conceiv'd the *Draught* of it in his Mind.

Arts also prove the *Beginning* of the *World*; seeing that most of them can be traced up to their first *Inventors*, and that not through any vast Interval of *Time*. For we know who first Invented the *Plough*; who furnish'd *Men* with the use of *Iron*, for the destruction of their own kind:

Who

VIII.
History
bears wit-
ness to the
Beginning
of the
World.

IX.
The same
proved
from the
Inventors
of things.

X.
The Eter-
nity of
GOD doth
not prove
the Eter-
nity of the
World.

XI.
Arts prove
the World,
not to be
of any long
standing.

who first taught the *Art of Fencing*; who, that of *Dancing*. But if the *VWorld* never had any *Beginning*, why were not *Things* and *Arts* improved many Ages ago to the same height, and beyond what they are now? How came it to pass, that the *Art of Printing* hath been so lately known in the *VWorld*? What was the Reason that *Vines* were no sooner *planted*; and that *Olive-Trees*, for the succession of innumerable *Ages*, were banished from the *Fields*? What can be imagin'd the Reason, why the *Mariners Compass* was not found out till near our *Days*, which is of that use to us for the *Crossing* of the *Seas*, and towards the discovery of New-found *Lands* and *Men*? All these *Instances* plainly overthrow the *VWorlds Eternity*, and prove it not to be of any very long standing. Which made *LUCRETIVS* say,

—— the *VWorld* is new,
Nor can it many Ages of its standing shew.

XII.
What time
of the
year the
VWorld
was made.

It is a thing controverted amongst *Authors*, about what time of the year the *VWorld* was made; some allowing this advantage to the *Spring*, and others to the *Autumn*. Tho' indeed I can see no Reason at all, why either of these *Seasons* should be preferred before the other, seeing that both continually reign in one part or other of the *VWorld*. Moreover, it seems absurd to determine the *Beginning* of the *VWorld* to one *Season* of the year, forasmuch as all the 4 are found in it. But if this *Question* be meant of that part of the *VWorld* where *GOD* at first *Created Man*, and where *Men* first inhabited, it seems probable that the *VWorld* was *Created* at the time when it was *Autumn* there; seeing that it is most agreeable to Reason, that all things were *Created* by *GOD*, and that nothing is made by him, but what is most absolute and perfect in all degrees.

CHAP. II.

Of the Creation of Things, and of the Ranging of the several parts of the World.

I.
The Creation
of Heaven
and Earth,
as it is
described
by Moses.

MOSES, whose *History* is owned not only by *Modern Philosophers*, but by the *Ancients* also, in the 1st Chapter of *Genesis*, describes at large the *Creation* of the *VWorld*, beginning with the production of *Heaven* and *Earth*, in which two, as the *Center* and *Circumference*, he comprehended the whole *Universe*: In the *Beginning*, saith he, *GOD* created the *Heaven* and the *Earth*: But the *Earth* which was cover'd with the *water*, and involved in *Darkness*, was empty and void. For the *Spirit*, or *Subtil Matter*, did lye upon the whole *Mass* of the *Earth*, to excite and stir up its sluggish consistence; yet because it was only moved in a huddle, and without any certain determinate motion, the *Earth* all this while continued void, that is, Invisible, until by the Commanding word of the *Almighty*, *Light* was made, which might distinguish the *Times*, and discover the distinct appearance of all things in their several places.

II.
How *GOD*
at first

For we are to suppose, that *GOD* having *Created* this *Immense*, *Extended Substance*, which fills the the *Length*, *Breadth* and *Depth* of the

VWorld, he divided the same into infinite *Parts*, some of one figure, and others of another; some greater, others less; and that this Variety is much greater than our *Spirits* can reach. We are also to conceive, that *GOD*, in dividing the *Parts* of the *VWorld*, hath not left any void Spaces between them; but that all the difference or division he hath made between them, consists in the diversity of their motion, which he hath given to every one of them; ordering it so, that from the very first instant of their motion, some of them began to move one way, and other another: To which if we add this, that the *Parts* of the *Matter* are impenetrable, it will appear evidently, that *GOD* could not continue to move them, without causing an infinite Variety in their motion, until at last they all agreed to move about different *Centers*, and consequently to constitute divers *Vortexes* or *VWhirlpools*.

And forasmuch as all *Bodies* that move *Circularly*, do continually endeavour to withdraw from the *Center* of their motion; and that the strongest always withdraw themselves further than the weaker, it follows of necessity that the *Matter* of the *Second Element*, which is more strong than that of the *First*, as being more solid, must withdraw themselves further from the said *Center* of their motion; and that in this their withdrawing, they drive downwards to the *Center* those *Particles* of the *First Element*, that are more than are necessary to fill the Spaces, which the *Particles* of the 2^d *Element* leave open between them. Whence it follows, that about the *Axis* of each *Vortex*, there must of necessity be a *Body* which is only composed of the *Matter* of the *First Element*, which every way pulseth the *Second Element*, that surrounds it, and pulseth it with Force enough, to have the motion transfinite, almost in an instant, at certain Distances. And it is in this pression of this *Subtil Matter*, which is at the *Center* of each *Vortex*, and which endeavours to withdraw from it, that that *Light* doth consist which appeared the first Day of the *Creation*.

But forasmuch as at the *Beginning*, there was not any great store of the *Subtil Matter* in the *Centers* of the *Vortexes*, the *Action* wherewith the *Globuli* were pressed, could not reach far; and therefore those Spaces to which the Effect of that *Action* could not reach, continued obscure, and cover'd with *Darkness*.

And accordingly, by this mixture of *Light* and *Darkness*, the *World* became distinguish'd into several *Provinces*, and by the penetration of the *Subtil Matter* through all *Bodies*, the thinner and more subtil *Parts* were distinguish'd from the more thick and gross, and the *light* from the heavy. And this was the Work of the *First day*, and an Argument of the *Omnipotence* of the *First Being*. For nothing was produc'd anew the following days, but the things already made were ranged and order'd, and a proper place assign'd to every *Body*.

And forasmuch as *GOD* could not move the *parts* of *Matter* with different or opposite determinations, without making them to hit directly or indirectly against one another, those which run against one another indirectly, must of necessity be reflected different ways, by *Angles* of *Reflexion* equal to those of their incidence: But they could

moved the
Created
Matter.

III.
How stars
came to be
formed in
the Center
of every
Vortex.

IV.
The First
Days work.

V.
How the
Vortexes
were form-
ed.

could not so reflect themselves, without meeting with other Parts, which turned them aside in like manner: So that meeting with a 2^d repulse, and afterward with a 3^d, 4th, and so on, they were at last forced to move about different Centers, somewhat in the same manner as the water of a River, is forced to move so, when it meets with new stops in its way; and thus made up several Vortexes, differently situated with respect to each other.

VI. On the 2^d Day, after that a Firmament was interpos'd betwixt the Waters, some of them had a place allotted above it, others under it, to water the surface of the Earth, and for the generating and feeding of Fish. For if we enquire into the Etymology of Firmament, we shall find it to signify no more than a great and diffused Extension, which we suppose to be nothing else, but the Disposition of the Vortexes, by means whereof they became so ranged, as that the Ecliptick of one Vortex, did answer to the Poles of its Neighbouring Vortexes, by which means they were so far from hindring the motion of each other, that they rather promoted the same. Whilst therefore the Heavenly Matter did continually run through these vast Bodies, the waters became divided from the waters; and those which covered the Earth, by the portion of the Firmament, were separated at a vast distance from those other waters which did lye upon solid and thick Bodies. And consequently, the waters that were under the Firmament, were divided from the waters that were above the Firmament. For it is evident, that Moses calls the Heavenly Bodies, Upper or Superior; and the Earth, Inferiour or Beneath, with respect to us.

VII. On the 3^d Day, the waters were gathered into one place, and the dry Land appeared; because when the Earth was wholly cover'd with water, so as that no part of it did appear, it seemed good to the Author of Nature, to gather the waters into some certain places, to the end that the Surface of the Earth being freed from them, might bring forth Grass, Herbs and Trees, from those several Juices, which running through the Bowels of the Earth, were joyned to divers Seeds, whose pores suited best with the figures of them. Whereupon the Earth was called the Dry Land; and the gathering together of the waters was called, Sea. But forasmuch as the Roundness of the Earth did hinder the water from running into one place, and that there was no Cavity sufficient to receive that immense Heap of waters, we are to believe that the Mountains were created on the same Day, and other Rising parts of the Earth, which leaving deep Vallies between them, made way for the Reception of the waters.

VIII. The Matter of the VWorld being thus orderly ranged, the next work was to adorn the same: For on the 4th Day, 2 Great Lights were placed in the Firmament of Heaven, that they might be for times, days and years; that is, that by them the Diurnal and Annual Circumvolution of the Earth, and the other Planets, as likewise the Circumvolutions of the Sun, might be known and determined. At the same time there were also created many Stars, having a Light of their own, which they dart abroad every way.

For seeing that the Matter of the First Element did continually increase, by means of the motion of the particles of the Second, and that there was a greater quantity of it in the Universe than was necessary, to fill those Spaces that are left betwixt the Globuli; all the remainder of it, after that those Spaces were filled, run to the Centers of the Vortexes, where it compos'd some most fluid Spherical Bodies, viz. the Sun and the fixt Stars. For after that the particles of the 2^d Element were still more worn away, they took up less place than they did before, and consequently did not diffuse themselves quite to the Centers; but equally drawing from them, left their Spherical Spaces, which were filled with the Matter of the First Element, flowing thither from all parts. And therefore the collection of the Subtil Matter, in the Center of our Vortex, in which the Earth is, with respect to it, was the Greater Light, or the Sun; and the Collections in the Centers of the other Vortexes, Stars: And that Matter, which of those great Masses which approached near to the Earth, was found most fit to drive the Light of the Sun towards it, became the lesser Light, that is, the Moon.

IX. On the 5th Day, GOD commanded the waters to bring forth Living Creatures, and the Fowl that fly above the Earth, in the Firmament of Heaven: And the Creeping things also, which without Feet crawl upon the Earth. And tho' the Scripture seems to attribute to Fishes and other Beasts, a Soul, produc'd out of the Water and Earth; yet nothing else is to be understood there by the word Soul, but only some Bodies in such a manner fitted and adapted to the Organs of Fishes, and other Animals, that they cause them to live, to feed and grow.

X. Lastly, After that the House was now perfected, and the Palace fully furnish'd and adorn'd for the reception of its great Guest, the Little VWorld enter'd the Greater, being endued with Life, Sense and Reason; that he might be the Lord and Commander of the Universe, to whom the Fishes of the Sea, the Birds of the Air, and all the other Living Creatures of the Earth, might pay their Homage and Obedience. These things thus order'd, GOD made an end of the Works he had made.

This Creation of the VWorld hath, by D A N Æ U S, been comprehended in short Verses, in his Christian Natural Philosophy; which in English speak thus:

The First Day made the Heavens, the Earth, and Light:

The Second, brought the Firmament in sight:

The Third, gave the Sea Bounds, and Grass to th' Earth:

The Fourth, to Sun and Moon, and Stars gave Birth:

The Fifth, made Fish o'th' Sea, and Birds o'th' Air:

The Sixth, gave Beasts, and Man, GOD's chiefest Care:

The Seventh, and last, appointed was for Rest.

XI.
Why the
World was
Created in
the time of
Six Days.

We need not here insist upon the Opinion of some of the *Jews*, who do not think it probable that the *World* was Created in 6 Days; and therefore do suppose, that this determination of Days, is to be taken *Allegorically*: To which some of the Ancient *Fathers* have been inclin'd; forasmuch as *GOD*, in Creating of the *World*, did not proceed in such a manner, as absolutely he might have done, but in such a manner as may be best understood and apprehended by us *Mortals*. For he ordered the *Creation* thus, that we *weak Men* might know, that he *works* nothing without the greatest exactness and order; because we are not able to conceive, how any Order could be observed in a simultaneous *Creation*.

CHAP. III.

Of the End or Destruction of the World.

I.
Whatso-
ever hath
had a
beginning,
must of
necessity
have an
End also.

FROM what hath been said, it is evident that the *World* was Created, and that those things that had a *Beginning*, are subject to *Corruption* and *Dissolution*. For why may not we attribute a Principle of *Destruction* to that, which we own to have had one of *Production*; and suppose that that which once began to be, will meet with a time wherein it must cease to be? For is not the *Matter*, whereof the whole *Universe* doth consist, the Original and Cause of *Dissolution*? And do not all things that we see, decay daily, and hasten to their End?

For he seems to be but little acquainted with *Natural Philosophy*, who supposeth that to be *Eternal* which hath had a *Beginning*, as *VELLEJUS* saith, according to the Opinion of *PLATO*, as *CICERO* sets it down in his 1st Book de *Natura Deorum*. For where can we find a thing put together, that is not subject to be taken in pieces again? Or, where is that thing which hath *Beginning*, and shall not have an *End*? And accordingly *LUCRETIVS* tells us, in his *First Book*.

*As Beasts depriv'd of Food, so things must die,
As soon as Matter fails of just supply.*

II.
The Opin-
ion of the
Ancients,
concerning
the Dura-
tion of the
World.

But you will say, that there have not been wanting some *Philosophers* who have attributed *Eternity* to the *World*, and have conceived this Great *Fabrick* so admirably contriv'd and built, as not to be capable of *Dissolution*. Which Opinion hath been maintain'd by *ZENO-PHANES*, *MELISSUS*, *ARISTOTLE*, and others, who accused those of *Impiety*, who maintain'd, that the *World* would perish. Neither were *PLATO* and *PYTHAGORAS* Enemies to this Opinion: For tho' they believed that the *World* would have an *End*; yet withal they supposed, that *GOD* only was to be the Dissolver of it; as thinking it unbecoming him, to make a *Work* that should be dissolvable by any other Hand than his own. That it is the property of *Parents*, to desire the preservation of their *Offspring*, and by no means to desire their *Destruction*.

But these are the *Judgments* of *Blind-men*, who without having a due regard to the Constitution of the *World*, thought the parts thereof to be joyned together by such strong *Ties*, which no *Ages* could be able to dissolve. But to oppose *Authority* to *Authority*, were not the *Epicureans* and *Stoicks* of another Opinion? The latter of whom supposed nothing to be *Immortal*, but *Jupiter* alone, and asserted that the *Earth*, *Sea*, *Air* and *Heaven*, were all to have an *End*, and to be changed into other *Bodies*; as the *Tragical Poet* seems to foretel, in *Hercul. Oct.*

*The splendid Roof of Heaven shall fall,
A certain Ruin doth it attend:
Yea, Glorious gods themselves, and all,
In Chaos and Dark-Night shall end.*

But what need have we of the Testimonies of the *Ancient Philosophers*, to assert the *Corruption* of the *World*; seeing that the present decays of the *World* do manifestly prove its declining, if not decrepit Age? Who doth not perceive, that all things are in a state of *Decadence*, and hastning on to their last end? Do not we see, that the *Seasons* of the year decline, and want much of their former force and vigour? Doth not the *Heat* of *Summer* grow less every year than other? And is not the *Winter Season* changed from what it used to be? How late, cold, and wet are our *Springs*? And how few seasonable and fruitful *Autumns* do we enjoy? So that all things apparently fall short of their *Primæval virtue*. If we descend into the *Bowels* of the *Earth*, what a small quantity of *Gold* and *Silver* do we meet with there? How few *Veins* of *Metals* are now-a-days discover'd, if we compare them with those multitudes that were found of *Old*, and in the *Times* of our *Forefathers*?

This Failure and Decrease is also observable in other things; for who doth not find, that there are not so many *Men* in the *World* as formerly, and that the *Fields* begin to want *Husbandmen*, the *Camps*, *Souldiers*; and the *Sea*, *Seamen*? And shall not we from this General defection conclude, that *Old Age* hath overtaken the *World*, and that all *Creatures* are hastning to their *Exit*? This therefore is the unalterable *Law* and *Decree* of *GOD*, that all things which have had a *Beginning*, must decrease, grow old, and die at last.

But what needs so many words to prove, that the *World* is grown *Old*, since we see that *mens Lives* grow shorter every day, being now contained within a narrow compass, as *LUCRETIVS* expresseth it in his *First Book*:

*Man's Age declin'd in Ancient Homer's days;
But now his Strength and Stature both decays.*

Formerly *Men* lived 800 or 900 *Years*, and upward; whereas now it is look'd upon as a *Prodigy*, to reach 100 only; and if any by great chance reach so far, then are they encumbered and tormented with so many *Ails* of *Mind* and *Body*, that they long for nothing more than *Death*. And shall we, after all this, suppose that the *Eternity* of this *World* can be consistent with the

III.
The World
is of its
own nature
Corrupti-
ble.

IV.
The general
Decadence
and Deli-
nation of
things.
Hence it
appears
like ap-
proaching
End of the
World.

V.
The short-
ness of the
Life of
Man is
an Argu-
ment, that
the World
grows Old.

the continual crumbling away thereof; the defec-
tion of the *Seasons* of the year, and the short-
ning of *mens* lives? Or that that can be perpetual,
which is always changing and fleeting?

VI.
The Ele-
ments con-
spire to the
destruction
of the
World.

Another *Argument* to prove the *Dissolution* of
the *World*, may be fetched from those particular
changes which antedate the total destruction of the
World, and divers ways conspire to the *Ruin* there-
of: What vast desolations hath not the *Fire* caused
in the *World*? How many *Countries* hath not the
Sun, whom they call the *Parent of Life*, and the
Soul of the World, laid waste and barren? How
often hath *Water* been destructive to the *World*?
How many *Deluges* have spoiled it, and reduced
it to little better than its primæval *Chaos*? And
for us that are yet alive, tho' we may hope to live
still longer; yet Reason, if we will not stop our
Ears against her, doth assure us that *Death* follows
us at the *Heels*, and will e're long trip us into
our *Graves*. And tho' we never saw the *Total*
Ruin of the *World*, or do not perceive any cer-
tain passages of its end, yet we have reason to
conjecture it not to be far off, since we find it
sick of the same *Diseases*, *Old Age* and other In-
firmities, which have led so many of her Off-spring
to death.

C H A P. IV.

Of the Generation, and Corruption of
Things.

I.
How Fire
becomes ge-
nerated out
of Wood.

Nothing is more common with us, than the
Generation of *Fire* out of *Wood*, by which
means a *Fluid* and *Subtil Body* is produced from
one that is *Thick* and *Hard*.

This *Generation* of *Fire* out of *Wood*, is not
by the Production of any *New form*, as the *Peri-
pateticks* hold, but from the alone disposition of
the *parts*; their situation and other modifications
which constitute the form of every *Body*. For no-
thing of the *substance* of the *Wood* is lost, when
it burns, and is changed into *Flame* and *Coals*,
only the connexion of the *parts* becomes changed,
and another mode of *Existence* is acquired: When
therefore, at any time, *Wood* is changed by *Fire*
into *Fire*, no new Being ariseth, that was not be-
fore; but the old *Being* or *Body* is so changed in
its *modes*, as that it seems to be a quite different
thing. For there is no other change made in *Ge-
neration*, save only that which is *Local*, whereby
things are so altered, as to appear as other things
to our *Senses*.

II.
The gene-
ration of a
Chicken.

This change of the Disposition of *Parts* is the
cause of the *Generation* of a *Chicken*; for we need
not make any difficulty to acknowledge, that the
first *Rudiment* of the *Chicken*, grows in the *Egg*
after the same manner, as the *Chickens* do that are
already *hatched*, viz. that all the *Fibres*, whe-
ther straight or crooked, whereof their *Organs* do
consist, become dilated by the addition of some
parts of matter, which joining themselves succes-
sively one to another, make the *Pullet* to grow by
little and little, and cause the parts of it to ap-
pear one after another.

III.
Whether
Salt be ge-
nerated out

Salt is generated out of *Burnt Wood*, as *Chy-
mists* well know, who in their distillations do se-
parate *Mercury*, *Sulphur* and *Salt* from *Bodies*;

the parts of which last *Body*, mingle with the
water, and become incorporated with it.

It is improperly that the word of *Generation* is
attributed to these kind of Extractions; forasmuch
as in them, there happens no adaption of parts, as
to *Figure*, *Quantity* and *Motion*; which is neces-
sary to the true Nature of *Generation*, but only a
separation of *Parts*. For the *Particles* of *Salt* be-
ing very small and slender, are easily overwhelm-
ed by the parts of the *wood*, which do never prick
the *Tongue*, nor become savoury, except they be
separated from the grosser parts thereof by *Fire*.
It is manifest, that an ounce of *Silver* may be so
thoroughly mingled with a great mass of *Gold*, that
there shall be never a part of the *Gold*, which
hath not some *Silver* joined with it: Neither will
any sound *Philosopher* affirm, that *Silver* is gene-
rated, when it is separated from *Gold*, by the
means of *Aqua-fortis*; but only that those *parti-
cles* which before were mixed with the *Gold*, are
now separated from it, and set at liberty. *Salt*
therefore, whilst it continues mingled with the
Wood, retains its own Nature, tho' it cannot be
perceived by the *Senses*, nor exert its force; and
that because it is covered over with innumerable
particles of *Wood*, and because the points of it are
blunted and broken by its being involved in other
Bodies.

Metals are sometimes dissolved by a vapor on-
ly, as is common amongst the *Chymists* to dissolve
Gold and other hard *Bodies* by External Heat, as
in *Hot Water*, by the *Balneum Mariæ*; or by a
Balneum Roris, that is, the steam only of *Hot*
Water.

This is performed, when the steam passing
through the *Pores* of the *Vessel*, and entering the
Pores of the *Gold*, doth dissolve the weaving of its
parts. For tho' that Heat be slow, yet because
it is of long continuance, it hath the same effect
as a drop of *water*, which by its perpetual fall-
ing, hollows a *Stone*, and penetrates to the inmost
parts of it. Hence it is that *Chymists* having ex-
perienced the virtue of this continual beat, do by
means thereof promise us wonderful *Fermentations*,
and hope to obtain their *Elixir*, which changeth
inferiour *Metals* into *Gold* or *Silver*.

Liquid Bodies often corrupt hard *Bodies*, so
water doth corrupt *Sugar* and *Salt*, for a pound
of *Sugar*, being cast into a large *Vessel* of *water*,
doth disappear in a short time.

Forasmuch as the insensible parts of *Liquors* are
in continual agitation, it must not seem strange to
us, that the *parts* of the *water*, do so shake the
parts of hard *Bodies*, about which they move con-
tinually, so as to make them leave their places.
Thus we see that the *Parts* of *Sugar* and *Salt*,
do vanish in a short time, and are so scattered
and dispersed through all the *parts* of *water*,
that there is not one which hath not its share
of it.

Some *Bodies* are altogether exempt from Cor-
ruption, as *Glass*, which cannot be destroyed by
the utmost violence of the *Fire*.

The Reason is, because every corruption of *Bodies*
proceeds from strange *particles*, intruding them-
selves into their *Pores*; and by this means alter-
ing and destroying, the *Texture*, *Connexion* and
Order of their *Parts*. And therefore those *Bodies*
that have more subtil and strait pores, are for the
most

of Wood,
or any other
matter.

IV.
How Metals
are dissol-
ved by Va-
pour only.

V.
How Li-
quid Bodies
corrupt
those that
are Hard.

VI.
Why Glass
is not sub-
ject to Cor-
ruption.

most part more durable, and less subject to corruption. And it is for this Reason that *Glass* is incorruptible; for tho' whilst it is red hot in the *Fire*, many particles do insinuate themselves into the Pores of it, and do dilate them; yet do they not enter into all the Pores thereof; so as that the least particles of *Air*, or *Water*, which do more closely cleave to those of the *Earth*, can wholly be separated from them, and consequently Exhale.

VII. Gold and Quicksilver are the most incorruptible of all Metals, because they have the most narrow pores of any other; as may be demonstrated by their Ponderosity. Wherefore also their parts cannot without great difficulty be separated from each other, by the Art of Chymistry; so as that the Form of Gold and Quicksilver be utterly destroyed, or that the Gold be reduced into its first Nature. The same also may be said of *Talk*, for the reduction of which into a watry Substance or Oyl, many Chymists have laboured in vain.

VIII. A Rotten Apple, if it be put to a sound one, doth corrupt it; so that frequently it happens, that many sound ones are spoiled by one rotten one.

Which effect proceeds from the steam which flows from the rotten Apple; which penetrating into the sound one, and agitated by the subtil matter that is in it, doth dispose the parts thereof in the same manner as they are disposed in the Rotten Apple. In like manner one Apple laid upon another, promotes Ripeness of each other: And therefore those that intend to make Cyder of their Apples, lay them up in heaps together, to make them ripen the sooner.

IX. Worms commonly breed in Vinegar, when it begins to be weakned and putrified; which are very small and long, and like little Serpents swim upon it.

Forasmuch as in every Corruption, the Connexion of the Parts is dissolved, by reason of the evaporating of the Sulphureous Parts, together with the dissolved Saline Particles, it happens that some of them breaking forth from the compound, do unite together in some near part, and there constitute these little Animals. After the same manner as Mites are bred in Cheese, and like Insects in the Grain and Fruits of the Earth; since it cannot well be questioned, but that soft Bodies are subject to perpetual intestine agitations, by which they are driven into Confusion.

X. In the mean time it seems most certain, that all Animals are the Products of certain Seeds; so as not so much as a Worm can be produced from the Tumultuary concourse of Atoms, but from a Seed, in which is lodged a formative Virtue: And therefore we must conclude, that the very least Animals are the effect of others; tho', it may be, it is not necessary that the Eggs whence they proceed, be produced from other Animals of the same kind. Which seems probable as to those Worms which breed in Galls and other Fruits.

XI. There is a Virtue found in Spices, whereby they preserve Bodies from Putrefaction: Hence proceeds the custom of Embalming Dead Bodies with Spices.

The Reason is, because Spices consist of those parts, which can easily be agitated by the subtil matter; so that by exciting a new fermentation in

Bodies, they put the matter, which before was at rest, into motion also, and put a stop to many of their out-flowing particles. Thus Flowers and Fruits are preserved by means of Sugar; forasmuch as by its clamminess, it retains their thin and volatil particles from flying away; and besides affords them a pleasant Taste.

The Grains of Wheat, being ground in a Mill or otherwise, is turned into Flower, which being mingled with water is kneaded into Dough, and afterwards being baked in the Oven, becomes Bread; which after it hath been chewed in the Mouth, and let down into the Stomach, is there by means of an Acid penetrating moisture turned into Chyle, and afterwards into Blood.

The Cause of which several Mutations is only to be attributed to Motion, by means whereof almost all alterations, that happen to Bodies are effected, and all that diversity is produced, which we see in Heaven and Earth. For we are not to imagine, that any new thing is acquired in the Generation of Things, nor any thing lost in their Corruption, that was before in them, besides only a new Connexion of Parts, and a different Mode of Existence. So that when the Grains of Corn are changed into Flower, afterwards into Bread, and lastly into Chyle and Blood; there is nothing in all this progress of changes, but local motion; tho' the Species it self may seem to be changed, as Ovid appositly describes the same in the XV. Book of his Metamorph.

All alter, nothing finally decays;
Hither and thither still the Spirit strays:
There's nothing permanent, all ebb and flow;
Each Image form'd, doth wander to and fro:
What was before, is not; what was not, is;
All in a moment change from that to this.

But where there is no such change, either of the insensible or sensible parts, there no alteration can be brought about; as appears in Gold, Quicksilver, Talk, and other Subjects, whose parts are so closely joined, as that they cannot by any force be separated; or so altered, but that they may return to their former appearance again.

Nothing is more common with Philosophers, than that Water is changed into Vapours, and Vapours again condensed into Water.

I know that the Peripateticks do not hold this change to be mutual, since they suppose in every Generation a new substantial form is acquired, and that the old one perisheth; and therefore ARISTOTLE expresseth himself thus, in his 2d Book of Generation, the last Chapter: When Air is turned into Water, and Water into Air, that Air will be the same Kind, but not the same in Number. But this doth not seem probable at all, seeing that in these changes there may be restitution of the very same parts. For as an Engine or Machin, that consists of 100 or 200 parts, when it is taken to pieces, can by a Skilful Artist be put together again such as it was before: So in like manner may water return again to its former subsistence and appearance, by the coming together again of the particles, which had been dissolved into vapour? Who will say that a drop of water, which riseth up in a vapour to the head of the Alembick, and there is turned into water again,

XII. How Corn comes to be changed into Bread, and afterwards into Blood.

XIII. How Vapours are said to return to Water.

again, is not numerically the same; seeing that all its parts may be again united, and take up the same Figure and place they had before. All the difference therefore that there is betwixt water and vapour, depends only on the motion and figure of its parts, because the parts of vapour are more agitated, and are at a greater distance from each other, than the parts of water, whose motion is less, and which takes up a lesser space.

XIV.
The change
of Bodies
depends on
the Trans-
position of
their Parts.

Thus we see that Wood, by a multifarious transposition of its parts is changed into Flame and Soot, and lastly into Ashes. Thus Vegetables, when they are putrified, turn into dust, or a slimy substance. Neither can we imagin any other way whereby Mites are bread in Cheeses, but that Flies or other Insects do lay their Eggs in them, which afterwards become dilated, and undergo various changes as to their figure, situation, &c.

CHAP. V.

Of the Heaven, or most subtil Æther.

I.
Why the
Heaven is
a most loose
Body.

THAT the Heaven is a most loose or rarefied Body, and consists of many most subtil parts, may be demonstrated from the Light of the Sun and the fixt Stars, which through the same is transmitted with unconceivable swiftness to an incredible distance. To which may be added the perpetual action of these Stars, and the excitation of Heat in these inferiour parts, by means whereof, tho' these particles had not been most subtil before, yet must they have necessarily become such, especially those which are higher, and nearer to the Lucid Bodies, as being more particularly the subjects of their Activity.

II.
What we
are to un-
derstand by
the word
Heaven.

For by the word Heaven, we are to understand nothing else but that immense Extension of the matter of the First and Second Element, which reacheth from the Star that is placed in the center of a Vortex, to the circumference of it. Thus the Vortex wherein we are, contains all that space in which the 7 Planets are whirl'd round; the middle part whereof is most swiftly snatched about, and all the other parts still slower, as they are at a farther distance from the Center.

III.
What is
the Cause
of the
Changes
that are
observed in
the Planet
Venus.

It is evident that the Heavenly Bodies are no less changeable, than those that are upon the Earth, and that they alter their Figures and Colours; as appears from those Phases or Changes that are observed in the Planet Venus, which differ but little from those of the Moon, and are much alike represented to the Eye.

IV.
Whence it
is that the
Planet Ve-
nus ap-
pears some

The Cause of these Changes is the motion of that Planet, which swimming in the fluid Heaven, makes its circuvolution about the Sun, and produceth new changes, according as it is carried above, below or sideways of the Sun. For seeing that the Planets shine with a borrowed Light they receive from the Sun; they likewise represent several Faces to us, suitable to their position, with respect to the Sun, as whether in Conjunction with it, Opposition to it, or any other Aspect.

It is notorious, that Venus doth at some times appear 40 times bigger than at other times; and that when she is biggest, she appears Crescent-wise, and Round when she is least. Which proves that Venus, when she appears round, is in her highest

station; and in her lowest, when she is seen like a Crescent. Which appearances do sufficiently evince, that Venus, as well as Mercury do not run round the Earth, but are whirled about the Sun; and consequently that our Earth is placed between Venus and Mars.

The Comets run through several Regions of Heaven, and are moved so swiftly, that within a few days they quite vanish from our Eyes. For they are found to pass through vast spaces beyond the Sun, and to run from one Heaven into another.

times greater, and at other times less.

V.
The Comets pass from one Heaven into another.

This Motion of the Comets is a strong and convincing proof of the fluidity of the Heavens, which we have demonstrated in our Institution of Philosophy, without which there could be no passage of Bodies through them. For how could the Stars or Comets move from one place to another, if they were surrounded with a Solid Body? The Comets therefore are swiftly moved through the Heavenly Spaces, because the Heaven is like our Air, tho' much more pure, which with the greatest ease yields to Solid Bodies, and makes way for them. But of the Comets more hereafter.

The Bodies that are moved in the Heaven, do pass every way without stop, and move with such a force, that they run through all spaces with an equal swiftness; the contrary to which we find in our Air; where the Birds cannot fly without wearying themselves, because of the opposition it makes to their motion.

VI.
The Bodies in Heaven, that are once moved, do always continue their Course

GASSENDUS, to avoid this difficulty, supposed empty spaces in the Heavens, to which he attributes the swift motion of the Stars, as supposing them void of all Matter, excepting only the Beams of the Sun and Stars which pass through them. He also supposeth that the Stars, how bulky soever they may be, have no ponderosity, and consequently that they do not stand in need of any Medium to support them; as Birds stand in need of the Air, and Fishes of the Water to bear them up. But forasmuch as we have already confuted this Opinion of Gassendus, and proved that there can be no Vacuity in the World; I shall only add one word, that in case a Vacuum be once admitted, there can no longer be any distance between those Bodies that are most remote from one another: Which is the same, as if one should say, that there is extended space in the World without extension; and that there is that which is high and deep, without Height and Depth. The Reason therefore why some Stars do freely wander through the Heavens, and meet with no stop in their Course in the Heavens, is not because the Fluid Body, through which they are carried, doth not hinder their motion; since it is a contradiction, that there should be any such Body in Nature; but because the parts of this Liquid Substance, which are variously moved, without tending one way more than another, are determined by the subtil matter; and complying with the motion thereof, are carried towards a certain Region of the Heavens. Not much unlike that which we observe in the other Scale of a Ballance; which with the least impulse from without, is either raised or depressed.

VII.
Why the
Heaven
doth not
hinder the
motion of
Bodies.

For as the *Particles* of the *Heavenly Matter* are most *subtil*, so are they most apt to admit motion, or any determination of it: Partly because most of them are of a *Spherical Figure*; and partly because the *Motion*, and the *Resistance*, which *Bodies* meet with in their *motion*, are proportionable to their *Bulk*: And therefore a weaker cause, and which is not endued with the greatest force, may easily suffice, either to push forwards these most *subtil particles*, or to determine their motion.

VIII.
Why the
Heaven,
when it is
clear, ap-
pears of a
Blue Co-
lour.

The *Heaven*, when it is free from *Clouds*, appears of a *Blue Colour*; which *Colour* also is seen at the *rising of the Sun*, if before *Day-break* it was full spangled with *Stars*: For then, as well in the *place* where they *shine*, as where they become extinct by the *Light* of the *Sun*, every way this *Blue Colour* doth appear.

This *Adventitious Colour*, is not so much to be attributed to the *Heavenly Body* it self, as to the *Vapours* and *Exhalations* which hang over us. For it is certain, that the *Heaven* sends forth no *Light*, and that indeed it would appear very dark to us, if there were not other intervening *Bodies*, which did reflect some *Beams* to us, or which sent back to our *Eyes* those *Globuli* of the 2d *Element*, which the *Sun* or *Stars* have dash't against them. For since these *Vapours* are very loose, and are very much dilated, the *Heavenly Globuli* do not meet with *particles* enough, so as to be with equal swiftness moved round their own *Centers*, as in a *straight Line*; and this is the Reason why the *Heaven* appears of a *Blue Colour*, as before hath been said. And it is for the same reason also, that the *water* of the *Sea*, where it is most clear and deep, shews of a *Blueish*, or *Sea-green Colour*.

IX.
Why the
Heaven
cannot be
really of a
Blue Colour

But that the *Heaven* is not indeed ting'd with a *Blue Colour*, is evident from hence, because if it were so, all the *Stars* which we see through it, would appear to us of the same colour, as those things which are beheld through a colour'd *Glass*, seem to us of the same *Colour* as the *Glass* is.

X.
How it
comes to
pass that
some new
Stars do
arise in the
Heavens.

Many *Stars* do appear in the *Heavens*, which were never seen there before; according to what *Astronomers* tell us of the *Star Meropus* or *Electra*; which having appeared in the *Heaven* a long time before the *Trojan War*, did afterwards vanish by degrees. TYCHO BRAHE also hath observed another, which shone for many years together in the *Heaven*, and afterwards disappeared.

The Cause of these and other *New Stars*, is by *Astronomers* attributed to the *Corruptibility* of the *Heavens*. For whatsoever is generated in another, doth borrow the matter whereof it consists from the same, and takes its Rise from the Dissolution thereof. There being no greater *Argument* of the *Corruptibility* of any thing, than that many things are generated and corrupted in it. But now more particularly, these *New Stars* do arise, or appear, when at any time the most *subtil matter*, collected in the *Center* of its *Vortex*, having dispersed its *Spots*, doth press the *Globuli* of the 2d *Element*, as before: Or when the matter of the first *Element*, flowing in great abundance from a neighbouring *vortex* to the obscured *Star*, doth diffuse it self over the *Spots* that cover'd it, whereupon it shines forth again.

CHAP. VI.

Of the Sun.

THE *Sun* is observed daily to describe a *Circle Parallel* to the *Aequator*, from *East* to *West*.

In order to the explication of which appearance, we are to suppose some things set down in our *Institution of Philosophy*.

1st. That the *Heavenly Matter* which surrounds the *Sun*, doth whirl continually round about it.

2dly. That the *Vortex* of the *Sun* carries the *Elementary Matter* along with it.

3dly. That the *Circle* which the *Elementary Matter* doth describe, is *Excentrical*.

4thly. That the *Axis* of the said *Circle* is always *Parallel* to it self.

5thly. That the said *Axis* inclines on the *Plain* of the *Excentrick Circle*, which the *Earth* describes.

6thly. That the *Elementary Mass* doth turn round about its *Center*, at the same time that it whirls about the *Sun*. These things thus supposed,

It is manifest that the *Sun*, and whatever else appears in the *Heaven*, must appear to us, as daily describing a *Circle Parallel* to the *Aequator*. For seeing that the *Earth* is turned about the *Sun*, the *Sun* also must appear to take the same course, and to describe a *Circle*; which would be the same with the *Aequator*, in case the *Axis* of the *Earth* were *Parallel* to the *Plain* of the *Excentrick Circle*, which it describes about the *Sun*, but which necessarily differs from it, and which it intersects, by withdrawing from it 23 degrees and an half; because the *Axis* of the *Earth* is just so much inclined upon the *Plain* of its *Excentrick Center*. The *Earth* therefore rolling about its own *Center*, from *West* to *East*, within the space of 24 hours, the *Sun*, and whatsoever else we suppose to be immoveable in the *World*, must needs appear as if it were carried by a contrary motion from *East* to *West*.

The *Sun* appears greater to us, when in the *Southern* part of *Heaven*, than in the *Northern*.

Because then the *Earth* is in its *Perigaeum*, or in that part of its *Excentrick Center* which is nearest to the *Earth*: And besides, the *Sun* must of necessity appear more days under the *Southern Signs*, than under the *Northern*; because the *Aequator* cuts the *Excentrick* of the *Earth* into 2 unequal parts; and that the *Earth* describes the greater half from the *Day* wherein the *Sun* doth appear to us under the *beginning* of the *Ram*, till the day that he enters the *Balance*; which is the reason that it makes more diurnal *Revolutions* in this half, than in the other.

The chiefest and most common effect of the *Sun*, is *Heat*; which it every way transmits to us. For wheresoever the *Sun-beams* come, they bring *Heat* along with them, and cause those effects, which we see the *Flame* daily produceth. And therefore PARMENIDES and HERACLITUS, as *Stobaeus* tells us, did believe the *Heaven* to be *Fire*, and that the *Stars* were so many flaming *Torches* placed in it; by which the *Light* is conveyed to us, and from whence, as so many *Fountains*, the vigour and life of all things here below do proceed.

They

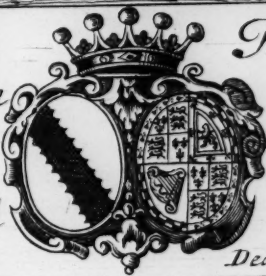
I.
Why the
Sun ap-
pears to
move from
East to
West.

II.
Why the
Sun ap-
pears greater
in some
Signs than
in others.

III.
How the
Sun is said
to be hot.



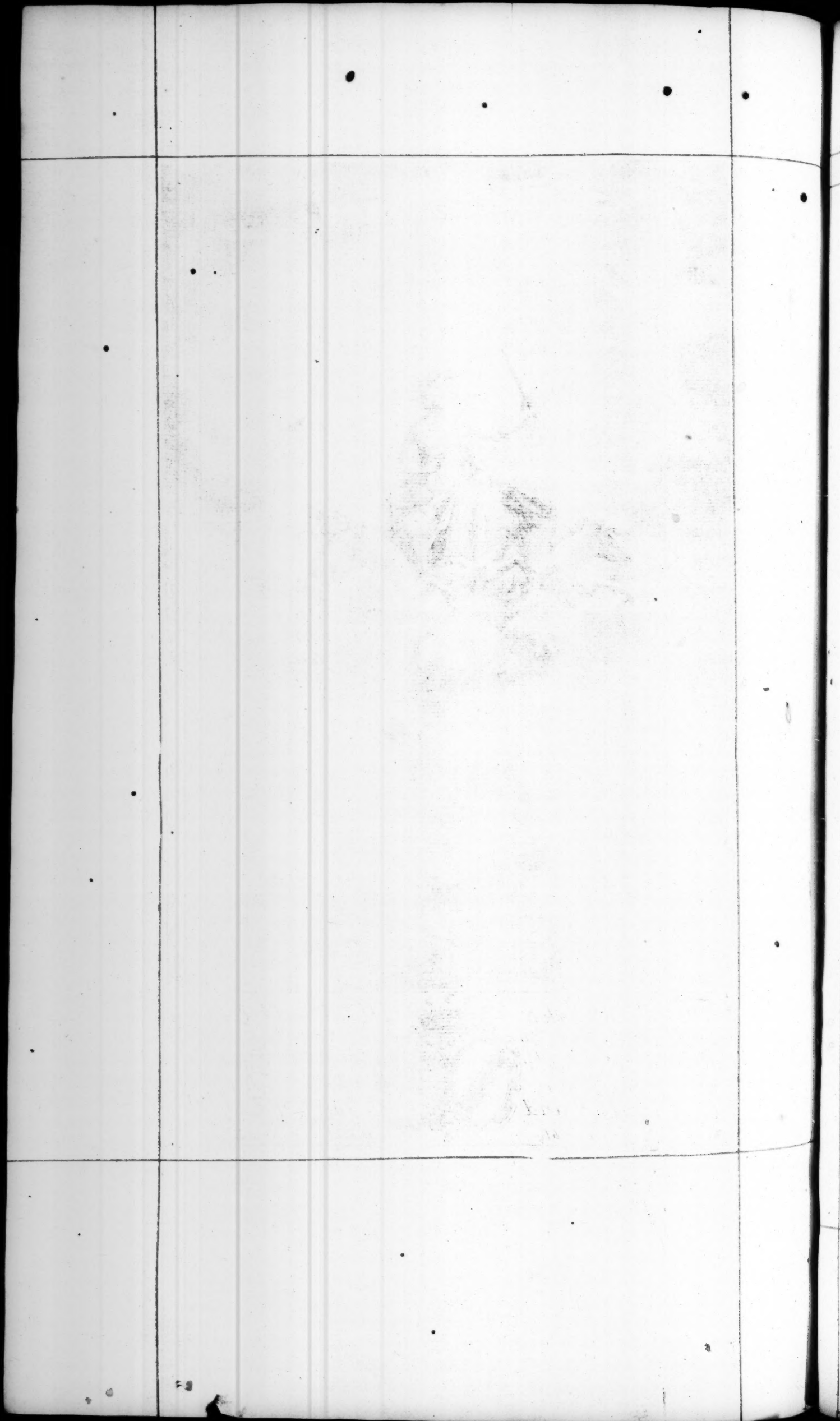
To the Right
Lord Radclyffe, Son
Right Honourable
Darwentwater,
& Langley, and



Honourable Edward
and Heyre of the
Francis Earle of
Viscount Radclyffe
Baron of Findale &c.

This Plate is humbly

Dedicated, by Richard Blome.



They who follow ARISTOTLE, attribute this effect to the *virtue* of the *Sun*, and not to its *substance*, which they will not allow to be endued with a *Fiery Nature*, and that it is only *virtually* hot; but not to the *Touch*. Like *Ginger*, or *Spirit of Wine*, which excite a *heat* in the *Mouth* and *Stomach*; tho' it cannot be felt with the *Hand*. But how doth it appear to these *Philosophers*, that the *Sun* is only *Eminently* hot, and not *Actually*? Were they ever so near it, as to touch it with their *Hand*? Had not they much better attribute a *Natural* and *Real* heat to it, since they find it in all things to be like *Fire*? There is nothing here on *Earth* that is more moveable than *Flame*, which by its great *Activity* and *Mobility*, dissolves all *Bodies*. Have not the *Astronomers* observ'd as much, who, with the assistance of an *Helioscope*, have seen the *Sun* in appearance of *Gold* boiling in a *Furnace*; or like a *Sea of Fire*, with its *waves* rousing through and over one another? And what else is *Formal Heat*, but the *various Motion* of the *Parts* of a *Body*, whilst they are diversly agitated and carried against one another? Now that this happens in the *Sun* no Man will deny, but he who is ignorant of the *Nature* of it. And as to the Instance they alledge of *Ginger* and *Spirit of Wine*, that makes more for us, than for them; seeing that they are not perceived to be hot, till the *subtil Matter* hath excited a *motion* in their *parts*, and separated them from each other. But the *Particles* of the *Sun* are in perpetual *motion*; and tho' they do not make any *Excursions* beyond the *Bounds* wherein they are contained; yet do they vary their *situation*, and are carried divers ways.

IV. The *Sun* commonly appears *Red* at his rising or setting.

Because the *Light* at that time passeth through abundance of *Nitrous Vapours*, which make it subject to *Refractions*, much like those which a *Prism* is the cause of; and we shall be easily persuaded to be of this Opinion, if we will take the pains to observe, that when we distil *Salt-peter*, in order to the making of *Aqua-fortis*, the *Vapours* which arise and circulate in the *Recipient*, do make a *Candle*, held on the other side of the *Recipient*, and viewed through those *Steams*, to appear very *Red*. And by the same Reason it is, that the *Sun* appears *red* to us, when we look upon it through a *Glass*, upon which we have put some *Ink* or *Soot*.

V. The *Sun* appears *round* to the *Eye*, especially if it be assisted with a good *Telescope*, whose *Concave-glass* is tinged with some *pale Colour*, especially a *Violet*; for then it doth not appear *Round* like a *Dish*, but *Spherical*.

The Reason of this is, because the *Matter* of the *first Element*, which constitutes the *Body* of the *Sun*, doth endeavour every way to withdraw from its *Center*, and by an equal pressure pusheth forward the surrounding *matter*. For it is a *Law of Nature*, that *Bodies* which are circularly moved, withdraw, as much as they can, from the *Center* of the *Circle* they describe, and consequently leave those *Round spaces*, which are afterwards filled with the *Subtil matter* of the *first Element*. And forasmuch also as the *Vortex*, wherein the *Sun* is formed, is on every side pressed by the encompassing *Vortexes*, and so is hindered from prosecuting

its *motion* in a *strait line*; therefore it must of necessity continue *Round*, and never attain any other *figure*. As appears in a *Glass*, which is formed of a *Round figure*, whilst the *Air* that is blown into it through a *Pipe*, doth equally press the parts of the *Glass* one way as much as another.

VI. The *Sun* seems sometimes to be of an *Elliptical figure*, viz. about his setting.

The Reason whereof is to be fetch'd from the *Refraction* of its *Rays*: For the *Sun-beams* are refracted in a thick *Vapour* about the *Horizon*, at a greater distance to the *Right* and *Left* hand, than upwards and downwards, as those that have skill in *Dioptricks* demonstrate; which it will be sufficient to have only mention'd here. For who doth not know that a *Circle* is changed into an *Elliptical* or *Oval figure*, by *Reflexion*, as in a *Cylindrical Glass*, and by *Projection* upon a *Plain* obliquely oppos'd; and also by *Refraction*.

The *Astronomers* never observed any change in the *Sun*, but own it to consist of the same *Bulk*, and to enjoy the same force and virtue, as it had from the beginning. Which some alledge, as an Argument to prove, that it cannot be of a *fiery Nature*, because *Fire* always stands in need of *Fuel* to maintain it, upon the withdrawing whereof it becomes extinguish'd.

Tho' the *Sun* be consider'd as a *flame*, and seems obnoxious to the same defects, as a *Flame* is; yet cannot we conclude from thence, that it stands in need of *fuel*, as our *fire* doth. For, according to the *Laws* of *Nature*, *Every Body* always continues in the same state, till it be forced by a foreign *Body*. Whence it is evident, that *Fire*, being of a *fluid* and *moveable Nature*, is easily destroy'd and choaked by the *Matter* that doth surround it, and that consequently it stands in need of continual *Fuel* to support it, that as fast as any of its *Matter* vanisheth, other may be restored in the stead of it. But the case is not the same with the *Sun*, whose *Ruin* is not conspired by the *parts* of *Heaven* that are about it. But yet it doth stand in need of some *aliment* or *fuel*, which is no other than the same *Matter* of the *first Element*, which as it runs out by the *Ecliptick*, or those places which are most remote from the *Poles* of the *Sun*; so new *Matter* enters again to the *Sun*, by the *Poles*, and recruits the defect of that which is gone away. Wherefore as a *River* is said ever to continue the same, as long as it is recruited by the continual succession of new *Parts* of *water*: So likewise the *Sun*, by this entrance of *New matter*, doth continue the same, and keeps the same *bulk* and *figure*.

Tho' the *Sun* causeth different *Seasons* over the whole *World*, and by his presence produceth *Heat* every where: Yet we find the contrary in the *Torrid Zone*, where there is nothing else, but continual extreme *Heat*, even when the *Sun* is most remote from it; whereas it grows weaker, when the *Sun* is perpendicular to it: So that they who live between the *Aequinoctial* and the *Tropicks*, do begin their *Summer* about *Christmas*, and their *Winter* about the *Feast* of *St. John Baptist*.

VI. Why the *Sun* sometimes appears of an *Elliptical figure*.

VII. The *Sun* always appears of the same *bulk* and *figure*.

VIII. Why the *Sun* is felt more hot in the *Torrid Zone*, than elsewhere.

This

This difference of *Seasons* proceeds from the *Sun* it self, which hovering directly over the *Heads* of the *Inhabitants* of the *Torrid Zone*, doth raise up many *Vapours* to that height, that by their meeting with the cold *Air*, they are immediately turned into *water*, and consequently cause almost continual *Rains*, which do very much cool and refresh the *Air*: But when the *Sun* is no longer perpendicular to them, the *Rain* ceaseth, and the *Air* being deprived of its coolness, grows so hot, as scarcely is tolerable.

IX.
Why the
Sun doth
blacken
some Men,
and not
the Fire.

In some Parts of the *World* Men are colour'd black, as those who live in *Guinea* and *Aethiopia*: Which effect the *Fire* doth not produce, tho' it exert a greater force upon *Bodies*, than the *Sun*. And hence it is that those who make *Glass*, are rather of a *pale*, than a *black Colour*.

The Reason whereof is, because *Fire* exerts its Force most upon the *Blood* and the *Spirits*, causing them to exhale; which makes *Men* that labour much in the *Fire* to be of a *pale* and somewhat *tawny Complexion*: Whereas the more benign *heat* of the *Sun* only draws the *Blood* towards the outward parts of the *Body*, and does rather concoct it there, than cause it to evaporate. And therefore it is that the *Ethiopians* are indeed of a *Fleshy habit* of *Body*, but not so well and handsomely made, and generally have thick *Hips*, which shews that their moisture is shut up rather, than exhausted.

X.
Whence
the Twi-
light, and
the differ-
ences
whereof do
proceed.

In the *Morning* before the *Sun* riseth, and in the *Evening* after its setting, we have the *Twilights*, which in some parts of the *Earth* are perpetual, and exclude the *Nights Dominion*.

The Cause of these *Twilights* is, when the *Sun-beams* falling obliquely upon the surface of the *Air* and *Atmosphere*, become refracted towards the *Earth*, and entering the same, are reflected back again by the particles of *Air* and *Vapour* they meet with. These *Twilights* begin and end, when the *Sun* is 18 Degrees distant from the *Horizon*; for if it sink lower, it makes *Night*. Whence it is evident, that in those *Countries* where the *Sun* in *Summer* time doth not sink 18 Degrees below the *Horizon*, there they enjoy a continual *Twilight*, and have no perfect *Night*.

XI.
Why the
Sun ap-
pears some-
times, to
be in the
place where
it is not.

This Refraction of the *Sun-beams*, is the cause that the *Stars*, which are near to the *Horizon*, do seem to make a stop there, and to set, as it were, with some delay or reluctance; and accordingly towards *Evening*, reach the *Lines* that point out the *Hours* on *Sun-Dials* more slowly, and so make the *Hours* longer. As also that sometimes the *Sun* appears together with the *Moon*, at the time of its *Eclipse*, tho' it be necessary for the producing of an *Eclipse*, that the *Moon* be interpos'd between the *Earth* and the *Sun*. And that the *Hollanders* in *Nova Zembla*, after a continual *Night* of 3 *Months*, see the *Sun* above their *Horizon*, and at the very *Meridian*, 15 *Days* sooner than according to the position of the *Sphere* they ought to find him there. The Reason whereof is, because the *Ray* which is betwixt the *Eye* and that Point of the *Atmosphere*, wherein the *Refraction* is performed, is not terminated in the *Sun*, but somewhat above it: Which is the true cause, why the *Sun* appears higher than indeed it

is. Thus the *Virgins Ear of Corn*, a very refulgent *Star*, appears to us to rise, when it is yet 32 *Minutes* under our *Horizon*; which we conclude from hence, because it seems to rise when the *Lions Tail* is 34 Degrees and 30 *Minutes* high, and in the same quarter in which that *Star* of the *Lion* then is. But the *Lions Tail*, and the *Spike of the Virgin*, are distant from each other 35 Degrees and 2 *Minutes*.

The *Eclipse* of the *Sun* always begins from the *West*, but that of the *Moon* from the *East*.

The Reason is, because the *Moon*, by her motion towards the *Earth*, doth with her Eastern part enter upon the Western part of the *Earths shadow*, as well as of the *Sun*. And therefore it is that she, in her Eastern part, begins to be *Eclipsed* by the Western part of the *Shadow*: and the *Sun* on the contrary, on its Western part, because of the Eastern shadow of the *Moon*. And forasmuch as that which last suffers the *Eclipse*, doth last recover its *Light*, it always happens that the *Eclipse* of the *Moon* ends towards the *West*, and that of the *Sun* to the *East*.

It is observed, that the *Heat* is not so great at the *Solstice*, when the *Sun* darts his *Rays* more perpendicularly down upon us; as some days after, when the *Sun* begins to decline from our *Hemisphere*:

The Reason is, because the *Sun*, in its approach to our *Horizon*, doth every day heat the *Air* with more direct and perpendicular *Rays*, and makes a longer stay above our *Horizon*, until the time of the *Solstice*. And since these direct *Rays*, together with this longer stay of the *Sun*, doth sensibly continue for some days; and that continually like degrees of *Heat* are still added to the *Heat* that is already acquired, it cannot be otherwise, but that the *Heat* by this means must be much increased. So that the *Heat* cannot decrease till the *Sun-beams* do very sensibly deflect from their former Directness, and till the stay of the *Sun* above our *Horizon*, be considerably shorter.

The *Sun*, when it is nearest to the *Horizon*, appears greater, than when it is farther from it, towards the *Meridian*; because there it is conceived to be highest.

The Reason of this Deception must be fetch'd from the Refraction of the *Rays* (according to the Opinion of almost all *Philosophers*) in the *Dewy Vapour*, which inflexion of the *Rays* doth dilate the visive *Angle*, and thereby increase the Bulk of the *Object*. For seeing that the *Vapour* is but lifted up a little way above the *Horizon*, on the Plain whereof, notwithstanding it is far and wide extended, it so happens that more of the *Solar Beams* do meet on this and that side, than upwards, and consequently make the longer *Diameter* of the *Sun*, which is then seen to be parallel to the Plain of the *Equator*. But the *Sun*, when it is about the *Meridian* and *Vertical* to us, doth appear higher, because the *Rays* which proceed from the *Sun*, passing through *Bodies* of different Rarity or looseness of the Parts, viz. the *Aether* and the *Air*, are refracted towards a Perpendicular, and therefore reach the *Eye* through a great *Refraction*. And thus it comes to pass, that the *Eye* apprehends the *Sun* to be much higher than indeed it is: For the *Eye*, or rather the *Mind* of *Man*,

XII.
Why the
Eclipse of
the Sun
always
begins at
the West
side, and
that of
the Moon
on the
East.

XIII.
Why the
Heat of
the Sun is
most vete-
ment after
the Sum-
mer Sol-
stice.

XIV.
Why the
Sun at his
setting, and
appears
greater,
than in the
Meridian.

Man, doth measure the Greatness of the Object according to the *Right Line*, which last of all reacheth his *Retina*, or Net-like-Coat of his *Eye*. it happens also that the *Ray* which is understood to be continued from the Point of the *Atmosphere*, whence the *Refraction* is made to the *Eye*, is not terminated at the *Sun*, but doth reach somewhat above him; where the *Mind* takes occasion to apprehend him higher than indeed he is.

It may also be said, that the *Sun* being near the *Horizon*, the *Eye* doth wink less, because of those *Vapours* which dull the *Sun-beams*, and therefore suffer the *Apple* of the *Eye* to be more dilated, than when the *Sun* being up on high, near the *Meridian*, there are few or no *Vapours* interposed between him and our *Sight*; by which means, when the *Apple* of our *Eye* is fixt upon him, it becomes the more contracted. Now it is evident, that the *Image* introduced through the more dilated *Apple* of the *Eye*, doth produce a larger appearance of the Object, than when it enters through a contracted *Apple* of the *Eye*. Because probably in the former case it doth strike more of those little *Nerves*, whereof the *Organ* consists. Thus we find that the *Moon* appears less in the *Day*, than at *Night*: For in the *Day-time* the *Hole* of the *Uvea* is more narrow, and therefore the *Rays* that enter through it being nearer to the *Axis*, are not so much dispersed.

XV. The *Sun*, at his *Rising* and *Setting*, seems to tremble, to whirl about its own *Axis*, and to leap, as it were, according to that of CLAUDIAN, in his 1st Book of the Praises of *Stilico*:

Then did Bright Titan's Horses lead a dance
To th' following Stars.

And hence it is, that that Story arose amongst the Common People, of the *Sun's Dancing* on *Easter-day* in the *Morning*; as believing, that all Created things do testify their Joy on that Day, because of our *Saviour's Resurrection*, and that the *Sun* in particular testifies the same by his *Dancing* at that time.

Some there are, that attribute this effect to the *Sun's turning round*, as if in so doing the *Brim* or *Edges* of it were really shaken, and so with a kind of *Palpitation* whirl'd round about his *Axis*: But this is found to be false, because the motion of the *Sun* about its own *Center* is insensible; which Rotation therefore cannot be perceived, but after many repeated Observations. This seeming Trembling therefore is caused, by those *Vapours* that interpose between the *Sun* and our *Eye*, which being agitated by its heat, do represent a kind of Trembling motion; and therefore the *Beams* that pass through them, do shake the *Retina* in such a manner, that the *Sun* appears to the *Eye* to leap and skip. In the very same manner as the *Sun* is seen to tremble on a *Paper*, or against a *Wall*, when the *Smoke* of a *Candle* doth intercept its *Rays*; or like as a *Stone*, that rests at the bottom of the *River*, seems to tremble, because of the *Stream* or *Current* of *Water* that runs over it.

XVI. If the *Heaven* appears Red at *Sun-rising*, it doth preface *Wind* or *Rain*; whereas at *Sun-set*, the same *Redness* doth promise *Fair-weather*.

Redness, appearing in the *Morning*, fore-bodes *Wind* or *Rain*; because this is a Sign, that seeing there are but a few *Clouds* in the *East*, the *Sun* may elevate many *Vapours* before *Noon*, and that those *Mists* which will produce the same, are already *Rising*. Whereas on the contrary, this *Redness* appearing in the *Evening*, portends *Fair-weather*; because this shews, that there are none, or very few *Clouds* gather'd in the *West*; and consequently, that *Eastern-winds* have the predominance, and that the *Mists* will be driven downwards during the *Night-season*.

the *Sun* rising, is a sign of *Rain*; and at his *Setting*, of *Fair-weather*.

C H A P. VII.

Of the Fixed Stars.

THE *Fixed Stars*, besides their motion from East to West in 24 Hours, have another from West to East, within *Circles Parallel* to the *Ecliptick*; according to which *Circle* they move only 2 Degrees in the space of 200 Years, and finish the whole Round in 36000 Years.

I. How the Stars are moved from West to East.

The *Diurnal*, or *Daily Motion* of the *Stars*, is evidently deduc'd from the Circumrotation of the *Earth* upon its own *Axis*; and as to the other Motion, which they call *Periodical*, it will be sufficient to say, that the *Earth*, when it wheels every year about the *Sun*, doth not so exactly observe its *Parallelism*; but that it doth, as it were, reel a little from it, by which means it comes to pass, that its *Poles* do answer to different parts of the *Firmament*, and that consequently its *Poles*, during the space of many Thousand years, describes a *Circle* from East to West. This being suppos'd, forasmuch as we conceive the *Aequator* of the *Earth* to correspond to different parts of the *Heavens*, it follows, that the *Aequator* of the *Earth* is changed after the same manner, and divides the *Ecliptical* at various Points, whose sequel is from East to West. And because the *Longitude* of the *Fixt Stars*, is taken from the common Section of the *Aequator* and the *Ecliptick*, it is necessary that the *Stars*, how fixt and immoveable soever they be, must every Hundred years appear, to have moved somewhat from the West to the East.

Wherefore it is no wonder, if the motion of the *Stars* be irregular, and that the *Astronomers*, who followed HIPPARCHUS, discover'd, that their motion from West to East was so much increased, that the *Longitude* of every *Star* was augmented to 28 Degrees, beyond what it was observed to be at the time of our *Saviour*. Because probably this Reeling motion of the *Earth*, may have been more manifest in one Age, than in another.

II. The motion of the Fixt Stars, is irregular.

The *Fixt Stars* do twinkle, and dart their *Beams* from them, as the *Sun* doth, who shines with a *Light* of his own.

III. The Fixt Stars shine with a Light of their own.

The Reason whereof is, because the *Fixt Stars* are as so many *Suns* in their proper *Vortexes*, consisting of a most fluid Matter, which with the greatest swiftness is whirled about its own Center: Whence it is that they always press that Matter, which is continuously extended from the *Stars* to our *Eyes*, and thereby produce the Sense of *Light*. For if the *Sun* were placed amongst the *Fixt Stars*, he would not appear greater to us, than the very

least of them: And on the other hand, if the *Little Dog-Star*, by Example, which is accounted the least of all the *Fixt Stars*, should be in the place of the *Sun*, there is no question to be made, but that he would be equal to the *Sun*, both in *Bigness* and *Light*. From whence we may gather, that the *Sun* hath not strength or force enough to lend his *Light* to the *Stars*, and that therefore we must conclude, that they must shine with their own proper *Light*, without borrowing it from any other *Body*: Tho' *PLINY* and *METRODORUS* were so much taken with the admiration of the *Sun*, that they thought him sufficient to illustrate the whole *World*.

IV.
Why the
fixt Stars
are con-
spicuous to
us, and not
the Co-
mets, when
they are
out of our
Heaven.

Hence it is, that the *Light* of the *Fixt Stars* reacheth our *Eyes*, and not that of *Comets*, except only when they are within our *Heaven*; because the *fixt Stars* having a *Light* of their own, do dart the same much more strongly, than the *Comets* can, who only reflect the *Light* to us, which they have borrowed from the *Sun*. And therefore cannot be seen by us, when they are too remote from our *Heaven*: For it is well known, that the greater the distance of any *Body* is, so much the less is the *Angle* under which it is seen by us.

V.
Why Stars
are seen by
us in those
places where
they are
not.

There are many *Stars* which are not seen by us in their *Right places*; yea, sometimes it happens, that one and the same *Star* appears in different places.

This proceeds from the *Vortexes* of those *Stars* that surround our *Heaven*: For their *surfaces* having several *Corners*, cannot be so aptly joyned, but that the *Beams* which proceed from them, must suffer divers *Refractions*. Whence it is, that when they are viewed from the *Earth*, they do not appear in those places, where indeed they are; but as if they were in those places of the *surface* of our *Vortex*, through which those *Beams* pass, which come from them to the *Earth*. And seeing that those *Places*, since the time that they were first observed by *Astronomers*, are not found to have been changed, therefore the *fixt Stars* are said to keep the same situation or distance from each other, and to continue in the same station. Which gave occasion to *MACROBIUS* to say; Behold the 7 *Stars*, which never scatter themselves from each other, no more than their Neighbours the *Hyades*, nor quit the station they have near to the *Constellation* of *Orion*. Neither do the *Great* and *Less Bear* desert their places; nor the *Serpent*, that glides between them, ever change the *Ring* wherewith he winds himself round about them.

VI.
Why the
Stars are
only seen
by Night.

The *fixt Stars* are not perceived by us, save in the *Night*; and in the *Day* time are inconspicuous to us.

The *Light* of the *fixt Stars* cannot be seen in the *Day* time, because the *Rays* of the *Sun* are of greater force, than the *Rays* of the *fixt Stars*, so as to disable them from affecting our *Eyes*. And therefore it is that by how much the nearer the *Eye* is to the *Sun*, the less can it perceive the *Light* of the *fixt Stars*: Because their Force becomes altogether weakened by the far more vigorous beat of the *Sun*; according to that Rule which always takes place in the meeting of *Bodies*, viz. That those things, whose Force exceeds that of others, they obtain their effect. Tho'

sometimes it may so happen, that *Stars* may in the *Day* time be seen by us, as, according to what *Historians* tell us, it hapned under the *Empire* of *COMMODUS*, when the *Stars* appeared for a whole *Day*, as if they had been fixed in the *Air*. The cause whereof I suppose to have been, because the *Sun*, at that time, being cover'd with *Darkness*, did give forth weak or almost no *Rays* at all, which being not sufficient to resist the *Action* of the *Light* of the *fixt Stars*, they consequently appear'd visibly to men. As we see that *Persons* let down into a *dark* and *deep Pit*, or *Well*, can thence see the *Stars* in the *Day* time.

The *fixt Stars* do always appear the same to us, and never increase or diminish their *Bigness*. Whence it is, that the *Stars* which pass over our *Vertical Point* in the *Crab*, are seen the same in *Capricorn*.

The Reason is, because the *Axis*, about which the *Earth* whirls round every *Day*, doth always continue unchanged. Whence it is, that that *Point* which is *Vertical* to us, when the *Earth* is in the *Crab*, is as far from that which is over our *Heads*, when it is in *Capricorn*, as the one *Tropick* is from the other in the *Great Orb*. But forasmuch as all this distance, and the whole *Great Orb*, is but as a *Point* with regard to the *Heavens*, therefore also the *Interval*, that comes between the 2 *Vertical Points*, is also to be esteemed no other than a *Point*.

New Stars do now and then arise in the *Heavens*, which some time after do vanish again: As that which appeared in the *Swan*, in 1600, much about the *Bigness* of one of the *third Magnitude*, and that other which appeared in *Serpentarius*, in 1604, which was almost of the same *bigness* with *Venus*; whereof the one continued for many years; but the other disappeared, after having continued its station for one *Year* only.

The Cause of the *Rise* of *New Stars* is, as was said before, the dissolution of *Spots*, wherewith sometimes the *Body* of a *Star* becomes so cover'd, that by their thickness, or hardness, they hinder it from shedding any of its *Rays*. When therefore it so happens that a *Star* becomes freed from those *spots*, by one means or other, then immediately a *New Star* appears to our *Eyes*, which it may be had not been seen for some hundred years before. Now the dissolution of those *spots* happens, when the *Vortex* that encompasseth the *spots*, doth with greater force press upon its Neighbouring *Vortexes*, than they push upon it: For then the said *Vortex* enlarging its own Borders, causeth the Matter of the first *Element*, which flows forth from the *Eclipticks* of other *Vortexes*, to run in greater abundance towards the obscure *Star*, where spreading it self over the *spot* that covers it, and making an impression on the *Heavenly Globuli*, it doth by this means convey the *Action* of the *Light* to our *Eyes*.

And on the other hand we find, that sometimes *Stars* which have appeared many years, afterwards disappear. Thus formerly the *Astronomers* counted 7 *Pleiades*, whereas now 6 only of them are to be seen.

The

VII.
The fixt
Stars al-
ways ap-
pear in the
same situa-
tion.

VIII.
How New
Stars come
to appear
in the
Heavens.

IX.
How comes
it to pass
that Stars
vanish
from our
sight.



To the Right
Elizabeth Countess
Winchelsea, Vis-
and Barones



Honourable.
Dowager of
countess Maidston,
of Eastwell &c.

This Plate is humbly

Dedicated by Ric: Blome.

The Reason whereof is, because the *spots* about these *Stars* grow so thick and close, that they can no longer be dissipated or dispelled by the said *Star*, nor the *Heavenly Globuli* be push'd forwards. Because nothing doth more conduce to the preservation of a *Vortex*, and keeping it from being destroyed, than when the *Star* that is in the Center of it, is in a vigorous condition to push forwards the *Globuli* of the 2d Element, and by that means hinders the neighbouring *Vortexes* from encroaching upon his Territories, and hurrying away of his *Globuli*. Thus the *Star* in *Cassiopeia* appeared in 1572, and the other in the *Breast* of the *Swan*; which being first discovered by *KEPLER* in 1602, vanished in 1625; and after this was seen again by the Famous *HEVELIUS* in 1656, of the same magnitude as it had before been observed by *Kepler*. About the beginning of the year 1650, it appeared less than formerly; and in 1661, it disappeared again till the year 1666. Thus at the beginning of this Century, there was a *Star* observed in the Neck of the *Whale*, which presently after becoming extinct, appeared again in the year 1648, till the Learned *BULLIALDUS*, had calculated the motion of it. For after a Circle of 333 days it appeared again. The same Reason must be given of that *misty Star*, which at sometimes is conspicuous in the *Girdle* of *Andromeda*.

X. *Stars* are seen in the *Day-time*, either when the *Sun* suffers a total *Eclipse*, or when the *Spectator* beholds them from the bottom of a deep *Well*.

For seeing that in these cases there is no reflexion of the *Sun-beams*, and that the *Spectator* is placed in nocturnal darkness; the *Apple* of the *Eye* being by this means dilated, and the *Optick Nerve* free from the dazzling splendor of the *Sun*, or at least being not compressed by it, the smallest *Beams* of the *Stars* are capable of affecting it, so as to make the *Stars* become sensible.

XI. The *Stars* are sometimes changed into *Comets* and *Planets*, and losing their own *Light*, only reflect that which they borrow from others.

The Reason of this is deduced from what was said before. For when a *Star* is altogether covered with *Spots*, and hath lost all its force of pushing forwards the matter of the 2d Element, it may easily be so prest upon by the neighbouring *Vortexes*, as to be swallowed up by one of his strong and vigorous *Neighbours*. And when the *Vortex* of the *Star* is thus swallowed, and the *Star* being wholly covered with *Spots*, and carried into another *Vortex*, it then either passeth farther, and is driven again from that *Vortex*, which first swallowed it, into another *Vortex*, and so becomes a *Comet*; or because of its being less solid, doth descend lower, keeping a certain distance from the *Star* which possesseth the Center of that *Vortex*, and thus becomes a *Planet*; and continually wheeling about the said *Star*, doth reflect its *Light*; and thus the *Body* which was *Lucid* and *Fluid* before, by the access of these *Spots* becomes hard and solid.

CHAP. VIII.

Of the Moon.

THE *Moon* hath always one and the same Face turned toward the *Earth*; neither could ever any *Telescope* inform us, that its *Body* hath changed its former situation.

The Reason is, because that part of the *Moon* which is furthest from the *Earth* is more solid, that is, contains more of the matter of the 3d Element, and hath fewer pores that are filled with the matter of the 1st and 2d Element. For it is apparent, that solid Bodies do withdraw themselves further from the Center of the *Vortex*, in which they are, than those which are less close, and abound with more Pores. Because they have a greater force to continue their motion, and to abide in the state wherein they were put at first. As it is evident in *Gold*, *Lead*, and other metals, which do longer retain the impulse impress upon them, than *Wood* or *Stones* of the same bulk and Figure. The Reason therefore why the same Face of the *Moon* is always turned towards us is, because that part of her which reflects *Light* from the *Earth*, is less solid, and doth contain less matter of the 3d Element, and therefore requires a less space to move in. Now that that part of the *Moon* which faceth the *Earth*, is less solid than the other part, may be gathered from those *Spots* and *Shades* which appear up and down in it; and which by letting in, and swallowing up the *Sun-beams*, produce darkness, and make an *Opake Body*.

But there are some *Philosophers* that pretend, that the *Moon* is whirled about her own *Axis*, all the while that she is turning round about the *Earth*, within the time of about 29 days and an half; because, say they, the *Sun* in a months time, enlightens all the parts of the *Moon* one after another. But it is an easie matter to make it appear, that the *Moon* will be enlightened in a months time in all its parts, tho' we should suppose it not to move at all about its own *Axis*, but only to be moved about the *Earth*.

For Example, let T be the *Body* of the *Earth*, S the *Sun*, B C D E the *Circle*, which the *Moon* describes about the *Earth* in 29 days and an half; and let the *Moon* be so placed in this *Circle*, as to be in *Conjunction* with the *Sun* at the point B, opposite to the point D, in her first quarter at the point C, and in the last quarter at the point E. This supposed, it is evident, that the *Moon* being at B, shall have her upper half 1, 2, 3, enlightened; and that being in her opposition to the *Sun* at D, her lower half 3, 4, 1, will be so. That when she is at her first quarter at C, the half of her 2, 3, 4, will be illuminated: And lastly, that when the *Moon* is in her last quarter at E, the half of her marked 4, 1, 2, will receive the *Rays* of the *Sun*. Which makes it evident, that the *Moon*, in order to her being illuminated in all her parts, hath no need to turn round about her own Center, seeing that her running through the *Circle* where-with the encompasseth the *Earth*, is alone sufficient for that purpose.

The *Moon* diffuseth her *Light* every way, and doth so reflect the same, as that the *Rays* do not unite in one point only, but are dispersedly reflected, and scattered every way.

I. Why the Moon hath always the same side turned towards the Earth.

II. An Objection answered.

Figure 14.

III. The Moon from all parts reflects Beams to the Earth.

This

This proceeds from the *Rugged Surface* of the *Sun*, which dilates the *Light* it receives, and shews its *Brightness* to all that behold it. For *Rough Bodies* do consist of many *Surfaces*; which are so disposed, as that some of them reflect their *Beams* this way, and others that way. But if the *Moon*, whom all *Philosophers* grant to be *Spherical*, were smooth and like a *Convex Looking-Glass*, not in all its parts thus *polish'd*, but in one part only; it would convey its *Light* to the *Spectators Eye* in one *point* only, as hath been before demonstrated. For certain it is, that an *Opake Globe*, having a *polish'd surface*, doth not reflect its *Light*, but as it were, from one point, as is manifest in *Brass Globes*, exactly *polish'd*, when they are expos'd to the *Sun*. For tho' the whole *Hemisphere* were expos'd to the *Light* of the *Sun*, yet would only the least part of the *Moon*, transmit the *Light* thereof to the *Eye* of a *Spectator*; which because of the smallness of it, and its vast distance from that *Star*, must needs be extinguish'd, before it could arrive to his *Eyes*.

IV.
Why the
Sun shines,
the compass
of the Moon
seems less
than in the
night-time.

When the *Sun* shines, the *Moon* appears less than in the *Night*: which GASENDUS assures us he had experienced by the help of a *Telescope*; and found the *Compass* of the *Moon*, at full in the *Night-times*, to be 5 minutes bigger than her true *Diameter*. Which may also be confirmed by a more familiar Experiment, viz. by beholding the *Moon* when it begins first to appear at eventide, whilst the *Sun* is yet above the *Horizon*: for then its *Crescent* will appear so very slender, that it appears but like a *Thread*; whereas when the *Sun* is wholly gone down, it grows broader and broader, as the darkness encreaseth.

This encrease of the *Light* must not be ascribed to the *Body* of the *Moon*, as if it had Power of sending forth *Beams* from it self, and of dilating them in the *Night-time*; but only because the *Aether*, or that *Matter* which is analogous to our *Air*, and encompasseth the *Moon*, is enlightned by the *Sun-beams*, which she reflects, and seems the same as the *Body* of the *Moon*: For being most intimately joined to the same, it is supposed to belong to the same *Circle*. But by making use of a *Telescope*, this false *Light* is easily discerned, for then that space, which is supposed to be illuminated, doth appear dark, and not at all touch'd by the *Arc* of the enlightned part.

V.
Why the
Moon is not
seen, whilst
she is in
Conjunction
with the
Sun.

The *Moon*, when in *Conjunction* with the *Sun*, doth not shed any *Light*, neither can she be seen till she be 2 degrees distant from the *Sun*. And afterwards changeth her *Faces*, according to her different aspects to the *Sun*.

This diversity of appearances is caused, for that the *Moon* doth borrow her *Light* from the *Sun*, and shines no otherwise than a *Looking-Glass* doth, which sends back the *Beams* that light upon it. Wherefore it is no wonder, if at the *Conjunction*, nothing of the illuminated part of the *Moon* be discerned by us, because then her whole enlightned half faceth the *Sun*, the other part being turned towards us. But during the following days, whilst she turns sideways, and hath a *Sextile Aspect* to the *Sun*, some part of her is perceived in the form of a thin *Sickle* or *Crescent*: But in the 7th or 8th day in her *Quadrant Aspect*, when she is one *Quarter* of the *Zodiack* distant from the *Sun*, the one half of her appears in sight. But whilst she is in the

3d part of the *Zodiack* distant from the *Sun*, above one half of her *Rim* doth appear; and on the 14th or 15th day, when the *Moon* is directly opposite to the *Sun*, her whole *Face* is turned to us.

The *Moons motion* changeth every day, hour and moment: for she moves most swiftly at the Full and New; and thence her *swiftness* decreaseth from the Full to the First *Quarter*, where she moves more slowly, and then her *Motion* encreaseth again till the New.

The Reason of this perpetual variety is, because the concave or hollow surface of her *Sphere* is not round but oval: So that the *Vortex* of the *Earth* must of necessity move with unequal degrees of swiftness in its circumference: For every *Fluid Body*, passing through a narrower space, doth accelerate its motion, as we see in a *River*, when it runs through the *Arches* of a *Bridge*, whereby it becomes straitned in its *Current*, and therefore is hastned in its motion, by the following water pressing upon it. Forasmuch therefore as an oval Figure hath one *Diameter* longer, and the other shorter, the *Fluid Aether* passing through the latter, where it is more straitned for *Room*, doth of necessity move more swiftly, than when it passeth through the longer *Diameter*, where it hath more *Room*; and because in every part of an Oval Figure, there is a different wideness or capacity, there must needs follow a variety in the swiftness of motion through those spaces of different wideness; and accordingly there must be a longer Oval *Diameter* betwixt the *Quarters*, and a shorter between the *Full* and *New Moon*, or thereabouts.

From what hath been said, we may easily be satisfied about the Reason of the variety of the *Distance*, *Bulk* and *Brightness* of the *Moon*; because when the *Moon* is in her *Quarters*, near the longer Oval *Diameters*, she is at a greater distance from the *Earth*, than in the *New* or *Full Moon*, when she is near, or at her shorter *Diameters*; and forasmuch as the *magnitude* and the *light* do grow or decrease equally with the distance, therefore the *Swiftness*, *Distance*, *Bulk* or *Splendor* must appear greater or less, not only about the four extrem oval *Points*, but at all the other points of the *Planetary Circle*, according as the Capacity or *Room* betwixt the oval sides of the said *Circle* is greater or less.

The *Moon*, whilst she is in an *Eclipse*, doth present an obscure light to our *Eyes*.

It seems probable, that this *Secondary Light* proceeds from the *Sun-beams*, reflected from the *Earth*: If we speak of that *Light* which is seen in the *New* or *Old Moon*; but that *Light* which appears in her, whilst she is *Eclipsed*, must be attributed to the *Refraction* of the said *Beams*, from the *Air* that surrounds the *Earth*. For seeing that the *Sun* doth continually dart his *Beams* against the *Earth*, they cannot be so admitted by it, but that they must rebound again from the *Earth* towards the *Sun*; and because the *Sun*, when *New* and *Old*, is in that *Region*, she must needs receive the more *Beams*, as she is nearer to the *Sun*. And accordingly it is necessary that the *Moon* be enlightned with the said reflected *Light*, especially in that part of her, which is not directly illuminated by the *Sun*; altogether in a like manner, as the *Earth* is enlightned by a light reflected from the

Body

VI.
Whence the perpetual variety of the Motion of the Moon doth proceed.

VII.
Why the distance of the Moon, from the Earth, is sometimes more, and at other times less.

VIII.
Whence the Secondary Light of the Moon doth proceed.

Body of the *Moon*, in that part of her which is turned from the *Sun*. Now that this *Secondary Light* doth proceed also from the *Refraction* of the *Air* that surrounds the *Earth*, doth appear from hence, because the *Globe* of the *Earth* encompassed with its *Atmosphere*, doth project a *Conical Shadow*, whose length consists of about 250 *Semidiameters* of the *Earth*. And because the *Sun-beams*, horizontally falling upon the *Atmosphere*, are according to *TYCHO*'s observation refracted at an *Angle* of 34 *minutes*; and that they double this *Angle* in their passage from it, therefore consequently they are united in the *Axis* of the *Shadow*, and there are decussated or cross one another, and so pass away, and produce the *Cone* of a *Shadow*, whose top, or extremity is not above 43 *Semidiameters* of the *Earth* high, on this side the *Decussation*, or before they come to cross each other; and beyond their *Decussation* an inverted *Cone*, which afterwards is confounded with the residue of the greater *Cone*.

The *Moon* \mathfrak{D} which moves round in a peculiar *Vortex* *A B C D*, that compasseth the *Earth* *T*, is whirl'd as swiftly again about the *Earth*, as the *Earth* whirls round its own *Axis*. For the *Moon* runs round her own *Circle* *A B C D*, which 60 times exceeds the *Circumference* of the *Earth* *T*, in the time that the *Earth* only 30 times runs round its own *Axis*, by its *Diurnal Motion*.

Tho' some boast themselves to have cleared this *Phenomenon*, yet there seems no other reason assignable of it, but only the littleness of the *Moon*. For seeing that the *Earth*, as well as the *Moon* itself, is moved by the same *Celestial Matter*, no other cause can be imagined of this greater degree of *swiftness* in the *Moon*, than that she is less than the *Earth*. For this is the *Rule* of all moving *Bodies*, that whilst one is moved as swiftly again as another that is twice as big, there will be but just as much *motion* found in the less *Body* as in the greater. Now so far as the *swiftness* of the *motion* of the *Body* of the *Moon* \mathfrak{D} , and of the *Earth* *T*, is from the *Celestial Matter*, which is much the same about the *Earth* as about the *Moon*; the *Earth* ought to whirl about as swift again, as it doth, in order to the running over its *Circle* 60 times in the same time that the *Moon* once runs through hers, *A B C D*, 60 times greater, but that its *Bulk* doth hinder it.

When the *Moon* *Riseth* or *Sets*, she appears to us much greater, than when she is high raised above our *Horizon*.

The Reason is, because when she is very high above our *Horizon*, there are no *objects* that interpose between her and our *Eyes*, whose *magnitude* is known by us; that by comparing her with them, we might be able to judge of her *Bulk*: But when she is newly got above our *Horizon*, or is near *Setting*, we see betwixt her and our selves many *Fields*, the largeness whereof is in some part known to us, by which we know her to be farther from us, and consequently judge her to be greater.

The *Moon* doth not observe an equal tenor in running through her *Circle*: For when she is in *Conjunction* with, or in *Opposition* to the *Sun*, that is, at *New* and *Full*, she is more swiftly moved than in any other of her *Aspects*.

The Cause of this *Inequality* of her *Motion*, is her particular *Heaven* *A B C D*, the *Circumference*

whereof is not absolutely *Spherical*, but is somewhat *Elliptical*. For when the *Globuli* of the 2d *Element*, which are comprehended within the *Circumference* *A B C D*, differ in *motion* and *magnitude* as well as *solidity*; it must needs follow, that the more solid ones must more freely diffuse themselves towards *A* and *C*, than towards *B* and *D*, and so constitute an *Oval* or *Elliptical Figure*. And therefore it is that the *Heavenly Matter* is more slowly moved betwixt *C* and *A*, which is the larger part of that particular *Heaven*, than that which is betwixt *B* and *D*, which is the more narrow part. For it is consonant to Reason, that the *Matter* which carries the *Planet*, should flow more slowly in a broader space, and more swiftly in a narrower. As is evident in *Rivers*, whose *Course* is so much the swifter as their *Channel* becomes more narrow, and more slow where it widens.

This *Oval Figure* of the *Moons Circle* also, is the Cause why the *Moon* at her *Conjunction* and *Opposition* is less distant from the *Earth*, than at her *Quarters*; and consequently is seen under a greater *Diameter* at the time of her *New* and *Full*.

There is one difficulty still remaining, which is this: If the *Moon*, because of its littleness, be capable of a swifter *motion*; how is it, that when she is carried about by the *Heavenly matter* that surrounds her, she doth not sink down towards the *Earth*; and why, leaving her *Circular motion* when she is at *C*, she does not decline towards *Z*, rather than go to *D*, and then turn upwards again.

We shall extricate our selves from this Difficulty, by considering that the *Moon* doth altogether follow the *motion* of the *Celestial matter*, tho' it have not all the degrees of *swiftness* which the said *matter* hath. For seeing that the *Earth*, and all the *Celestial matter* contained in the *Vortex* *A B C D*, is turned round about the *Center* *T*; it follows, that the *Moon* which is whirl'd about the *Celestial matter*, must continue its *motion* towards the *Center* of the *Earth* *T*; and that after it hath reached the point *C*, it does not proceed towards *Z*, but goes towards *D*; and that because the *Heavenly matter* drives it that way, and carries it along with it.

It is a common received opinion, that the *Moon*, as she appears under several *Colours*, presages changes of *Weather*: Which gave occasion to these Verses.

The Pale Fas'd Moon, gives Rain;
When Red, 'twill blow amain:
But when she's Fair and Clear,
Like Weather will appear.

But we must not imagine that this variety of *Colour* is in the *Body* of the *Moon*; but in that exhalation or steam which is between the *Eye* and it. Hence it is, that when *Rainy Clouds* are interpos'd between our sight and the *Moon*, she appears of a *Pale* and *Dusky Colour*; and again *Red*, when she is surrounded with many windy exhalations, and a moderate quantity of *Vapour*. It being a thing notorious that *Colours* are changed, according to the diversity of the *medium* through which they are transmitted. And accordingly when the *Air* is free from all manner of *Exhalations*, then the *Moon* appears fair and Clear.

G E

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IX.
Why the
Moon is
moved
more swift-
ly than the
Earth.

Figure 29.
in the Infi-
rutions.

X.
Why the
Moon ap-
pears greater
at her
Rising and
Setting,
than when
she is ele-
vated a-
bove the
Horizon.

XI.
The Moon
moves
swifter at
the New
and Full,
than in
other parts
of her Circle.

XII.
Why the
Moon is
beheld un-
der a greater
Diameter
at her
Conjunction
and Opposi-
tion.

XIII.
How it
comes to
pass, that
the Moon
doth not
fall down
to the
Earth.

XIV.
Whether
the Colours
of the
Moon be
any certain
Signs of the
Weather.

XV.
Why Eclipses of the Moon do appear alike, to those that live in the same Hemisphere, but not those of the Sun.

An Eclipse of the Moon appears alike in Quantity, to all those who live in the same Hemisphere of the Earth, and have the Moon above their Horizon. Whereas a Solar Eclipse appears to some Inhabitants of the same Hemisphere, Partial; to others, Total; and to some again none at all.

The Reason hereof is evident from what hath been delivered in my Institutions of Philosophy. For seeing that the Moon is destitute of any Light of her own, she must of necessity appear as much to some, as she is perceived of others deprived of Light. Whereas the Sun having an inborn Light of his own, and being only hidden by the Body of the Moon, which is interposed between the Sun and the Earth, and is less than either of them; it may so happen, that some part of the Earth appearing equal to the Sun, or bigger, may hide the whole Sun; another the half of him; another a greater or less part; and another again no part at all. Thus that Eclipse which THALES is recorded to have observed about the Hellespont, was Total; whereas at Alexandria in Egypt, it was only of 9 digits, with 3 fifts: Or as CLEOMEDES reports it, of 4 fifts of a Diameter.

CHAP. IX.

Of the Planets, Mercury, Venus, Jupiter, and Saturn.

I.
The Planets, Mercury and Venus, seem to move variously.

MERCURY and VENUS appear sometimes to move from East to West; and at other times the contrary way, from West to East.

Forasmuch as the Earth is turn'd round about its Center from West to East, within the space of 24 hours, it follows that the Planets, Mercury and Venus must seem to move from East to West, and every day to describe a Circle Parallel to the Equator. In like manner they must also trace a Circle about the Sun from West to East; forasmuch as they are comprehended in the Heavenly matter, which carries the Earth that way.

II.
Why the fore-said Planets are more swiftly carried about the Sun, than the Earth.

These 2 Planets are also more swiftly rolled about the Sun, than the Earth, which doth not finish its Circumvolution in less than a Year.

The Reason is, because the Circles which Mercury and Venus run through, about the Sun, are lesser than that in which the Earth is carried; and therefore it is necessary, that the true Circumvolutions of these 2 Planets be absolved in less than a years time.

III.
Why Mercury and Venus seem to move more slowly, than indeed they do.

These 2 Planets seem to take up more time in their Circumvolution, than indeed they do.

The Reason is, because if we fix the beginning of one of their Revolutions, when these Planets are placed betwixt the Sun and the Moon, this Period cannot be said to be finished, till they be come back to the same place again. Now forasmuch as the Earth it self hath changed its place, whilst those Planets run through their Circles, and at the end of their circumvolution is no more at the same place where it was at the beginning of it; it follows that the appearing Period of every Planet, must of necessity comprehend, not only the whole Circumvolution it hath absolved; but besides all that space to which the Earth hath past through during the time of the Planets Circumvolution.

CASSINUS observes concerning the Planet Mercury, that the same is scarcely visible, because of his great nearness to the Sun, so as that it but very seldom gets free of his Rays. For he is not above 27 or 28 degrees distant from the Sun, and often turns back to the Sun again, by that time he is got 18 degrees from him, so that his greatest elongations, from the Sun, do not differ above 9 degrees from each other.

The Circle of Mercuries Motion divides the Ecliptick; and with it makes an Angle of 6 degrees; so as that the line of Section, is not far from the Center of the Sun. The Northern Intersection, which some call the Node, is reduced to the 13th degree of Scorpio: and these Nodes proceed one degree within the space of 40 years.

Forasmuch therefore as Mercury doth not appear to us, but in his withdrawing from the Sun, he can scarcely be perceived with the help of a Telescope, in the form of a Globe or Round Body, but sometimes as if he were cut in 2, as the Moon appears at her Quarters; and sometimes more swell'd, and at others more deprest. And when at any time he is near the Horizon, or darkned with vapours, then nothing but his Bulk or Figure can be detected. However it is apparent that he receives his Light from the Sun, and is carried round him.

Concerning the Planet Venus, the fore-said Cassinus hath observed; first that this Planet is sometimes 40 degrees and an half distant from the Sun, that is, as far as the Moon at 4 days old is distant from him. Tho' sometimes it happens that she returns to the Sun, after a recess from him to 45 degrees; so as that the furthest elongations of this Planet do not differ above 2 degrees.

The Aphelium, or farthest distance of Venus from the Sun, is in the 2d degree of Aquarius; her Perihelium, or nearest approximation in the 2d of Taurus: and these Points do continually move onwards towards the East, so as that within the space of 46 years, they proceed one degree.

The fore-said famous man found that these 2 Planets moved about their own Centers. For when in the year 1666, he had observed one part of Venus to be brighter than all the other parts of her Circumference, on the 14th of October, 5 hours and 15 minutes after Noon; and the year following on the 24th day of April, about a quarter of an hour before Sun-set, had found the same bright part, near to the Line which separates the Lucid part of Venus from the Opake, and distant from her Southern Horn, above a quarter of the Diameter of Venus: and when after Sun-rising he had observed that the said Bright Part was further removed from the Southern Horn, from which it was distant the 3d part of her Diameter; he immediately concluded, that some kind of motion, at least, must be assigned to the Globe of Venus, tho' he dares not determine whether the same be a motion of Rotation, or of Libration only: Because Venus doth not present her self to her view but for a short time. But supposing that bright part, which he had so often seen, to have been always the same, he is not afraid to affirm that the said motion is finished in about 23 hours; after which the said bright part of Venus returns again to the same place.

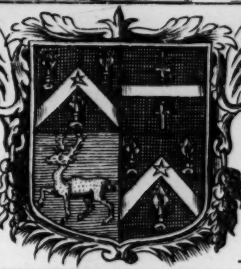
IV.
Cassinus his Observations about the Planet Mercury.

V.
Cassinus his Observations about the Planet Venus.

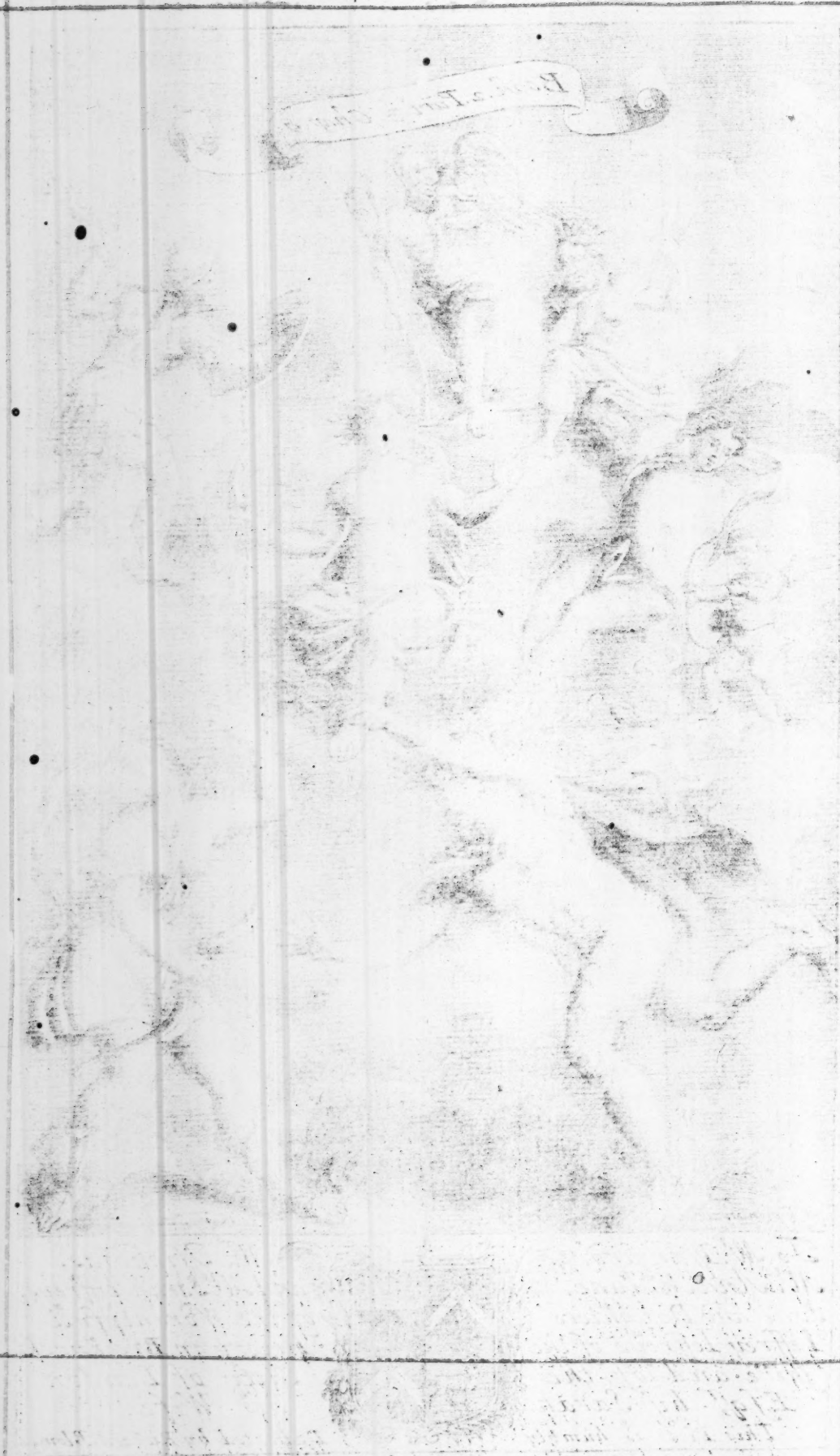
Mars,



To M^r. Edward,
M^{rs}. Ann, M^{rs}. Jane,
Sons and Daughters
Jeffrey Jeffreys of the
shire and of the
Esq^r by Sarah
This Plate is humbly



M^r. Nicholas,
and M^{rs}. Sarah Jeffreys,
of the Worshipfull
Priory in Brecknock
Citty of London
his Wife.
Dedicated by Richard Blome.



VI.
Why Mars,
Jupiter,
and Saturn
do une-
qually ob-
serve their
Course.

Mars, Jupiter, and Saturn, seem to roll about like other Planets, within the space of 24 Hours, from East to West about the Earth; but not equally within the same term of Time.

The Reason is, because the Circles they describe do include the Circle of the Earth, and because they, as well as the Earth, do swim in the Celestial matter; and consequently must appear, as the other Planets, to turn from East to West, within the space of 24 Hours. And forasmuch as, according to the Law of Mechanicks, the Circles which Mars, Jupiter, and Saturn do describe, must be found under the Zodiack, and are greater than that which the Earth moves in, we shall easily apprehend, that they cannot finish their Circuit in so short a time as it doth. Accordingly we know, that Mars takes up 2 years in performing his Circumvolution, Jupiter 12, and Saturn 30; for they being at a farther distance from the Sun, than the Earth, the Heavenly matter which carries them about, must take up the same time in abolving of its Course.

VII.
Cassinus,
his Obser-
vations
concerning
Mars.

CASSINUS also gathers from those spots, that obscure the Aspect of Mars, that this Planet moves about his own Center, in the space of 24 Hours and 40 Minutes, because these spots return to the same place, at the same distance of time. He observed in Mars one part more bright than all the rest, and always in the same situation; tho' the other spots had their different places.

Jupiter, when he is in Conjunction with the Sun, appears at a greater distance to us, than when he is in opposition to him; insomuch that we see him almost bigger by one half, when he is oppos'd to the Sun, than when conjoyn'd with him. And Mars appears five-fold greater, when he is nearest to the Earth, than when he is at his furthest Elongation from it.

VIII.
The Secon-
dary Plan-
ets about
Jupiter,
first disco-
ver'd by
Galilæus.

GALILÆUS, in the year 1610, the 7th of January, at the first Hour of the Night, discovered 4 less Planets about Jupiter, which like so many little Moons are whirl'd round him. Those of them which are nearest to Jupiter, move more swiftly, than those which are more remote. The Revolutions of which secondary Planets are thus calculated by SIMON MARIUS:

The first and inmost of them takes up,				The Second.			
D.	H.	M.	S.	D.	H.	M.	S.
1	18	28	30	03	13	18	0
The Third				The Fourth.			
D.	H.	M.	S.	D.	H.	M.	S.
7	03	56	34	16	18	09	15

These Attendants of Jupiter, whenever they enter the Verge of his shadow, do suffer an Eclipse after the same manner, as the Moon doth when she dips in the shadow of the Earth, and are totally depriv'd of Light; as being Opaque Bodies, which borrow their Light from the Sun. The 3 first of these in every Revolution, produce 4 Eclipses; the 1st, when the Satelles enters into the Rim of Jupiter; the 2d, when the shadow of the Satelles doth darken the Rim of the said Planet; the 3d, when the upper part of Jupiter,

at his Elongation from us doth hide the Satelles; and the 4th, when the Satelles dips in the shadow of Jupiter. So as that the first Satelles, within the space of 7 Days, doth effect 16 Eclipses; the second, 8; the third, 4; so as that all of them together produce 28 Eclipses. The fourth, after that he hath reached the Nodes, doth make 4 Eclipses in 17 days; but when near his bounds, he never suffers a defect of his Light, because his Latitude is so large, that he never touches the Rim of Jupiter, or reacheth his shadow. These Eclipses are of great use, in order to the determining of the Longitudes of Places.

Saturn hath also been found guarded by 3 Satelles: The first of these was discovered by CASSINUS, at Paris, in the Royal Observatory, in the Year 1672; and the same is remov'd from the Center of Saturn, 1 Diameter of the Ring, (mention'd by the Author, Chap. 16.) and 2 Thirds, and abolves his motion about the Planet in 12 Days, 4 Hours, and 27 Minutes. The second was long before detected by HUGENIUS, and is much more bright than the former; and is distant from the Center of Saturn, 4 Diameters of the said Ring, and turns round him within the space of 16 Days and 23 Hours. The third was first observed by CASSINUS, in the year 1671, towards the End of October, at his furthest digression from Saturn. But soon after he vanish'd out of sight, and did not appear again till the 15th of December; and presently after disappeared, until about the beginning of February 1673, when he continued in sight for 13 Days together.

No other Reason seems assignable for this great variation of Light in this last Satelles, than that some part of his Body doth strongly reflect the Light, whereas the other cannot do so. According as we see it happens in the Globe of Earth, where that part which is cover'd with water, is not fit to reflect the Sun-beams; whereas the other parts of it send them back every way. This Satelles therefore either is rolled about his own Center, or else is carried about Saturn, as the Moon is carried about the Earth. And therefore when that part of him, which is like the Continent of our Earth is turned towards us, then we see him, and he vanisheth again from our sight, when that part which is of the Nature of Sea, faceth the Earth.

They who first observed Saturn with a short and imperfect Telescope, were astonish'd when they perceived him sometimes of an Oval figure, sometimes as having 3 Bodies, that is, with 2 other added to the middlemost; sometimes solitary and perfectly round. But when these unlook'd for Appearances had stir'd up others to the viewing of this Planet, some making use of more exquisite Instruments, found, that those which before were taken to be the Lateral Globes, were in the figure of Handles or Arms, that is, hollowed out and bent, so that joyned to the middle Globe, they constituted a figure not unlike a Weavers-shuttle. But at last, by the use of the most absolute Telescopes, it was found that this Planet hath a round Body, as all the rest; but hath this peculiar, that it is encompass'd, as it were, with a broad Ring, not much unlike the Brim of a Hat, when the Head is out of it; or that of a Dish,

IX.
The Satel-
lites of
Saturn,
discover'd
by Cassinus
and Hugenius.

X.
What is
the Cause
of the
variation
of Light,
which is
observed
in the last
Satelles of
Saturn.

XI.
Why Sa-
turn ap-
pears un-
der differ-
ent figures.

Dish, when the bottom or hollow is taken away. And therefore this *ambient Body*, which before was called the *Handle* or *Arms* of *Saturn*, was since called the *Ring*.

In order to the explaining of this *Appearance*, we must represent to our selves this *Planet*, as a great *Globe*, resembling that of the *Earth*, and in which we conceive 2 *Poles*, an *Equator*, and a *Torrid Zone*; and that round about the said *Torrid Zone* there is elevated an opaque *Matter*, which fills the space of a considerable breadth, and is disposed in the figure of a *Ring*, resembling that broad *Circle* we call the *Horizon*. This being thus supposed, it is certain that we must of necessity see *Saturn*, according as he appears at A, when we view him from a place that is much higher than the *Level* of the *Ring*; afterwards he must appear to us, as at B, or at C, when we behold him from a place where we are not so high as the said *Level*. And last of all he must appear altogether round to us, as at D, when we are so placed with respect to his *Body*, that if his *Ring* were continued, it would pass through our *Eye*; for then the inconsiderableness of the *Thickness* it hath, by reason of its great distance, makes it altogether invisible. To which may be added, that probably we fail of seeing this *Ring* of *Saturn*, because this *Planet* passing over against some *fixt Star*, and having deprived us of the view of it by one of the *Tops* of the *Oval G*, in the *Figure A*, the said *Star* will afterwards be seen at the place E, where we see a kind of *Blackness*, which is nothing else but the defect of the *Circle*, and a part of the *Heaven*, which offers it self to our view, by that space which remains betwixt the said *Ring* and *Body* of *Saturn*.

Figure
15.

CHAP. X.

Of the Spots about the Sun, and the fixt Stars.

I.
The Sun
viewed
through
a Telescope,
appears
dark and
shaded.

THO' the *Sun*, to an unassisted *Eye*, appears bright, and to have an uniform *Aspect*; yet when we make use of a *Telescope*, with 2 *Convex-Glasses* in the figure of *Lentils*, it doth represent such a vast variety of *bright* and *shaded Bodies*, as if it were nothing but a continued *Checker-work*.

This various mixture in the *Body* of the *Sun*, is not caused by the fore said *Glasses*, as some have feigned, supposing that they, by reason of their *Impurity*, might represent *shadows* to our *Eyes*: Because when those *Glasses* are turn'd round, the *Solar spots* are not turned round with them, but keep their former situation: And moreover those of these *spots* which one day are seen towards the *East*, in the following days move forwards and are seen towards the *West*. These *spots* therefore of the *Sun*, are generated from those *striate Particles*, which entering through its *Poles* do run towards the *Center*; from whence, because of their irregular figures, which they have got by passing the *Triangular spaces*, they are expell'd, as not being able to comply with the motion of the *subtil Matter*, which whirls round in the *Sun's Center*, and are cast off like *Scum* from a *boiling Liquor*; so that being endued with rugged and many *Corner'd figures*, and running round more slowly

than those which wheel about with the *Sun*, they become easily entangled and grow to a great bulk, which being contiguous to the *Sun*, and lying upon the face of it, do cover and involve it with *Darkness*.

It seems very probable, that as *Steams* do proceed from the *Body* of the *Earth*; so likewise *Fumes* and *Vapours* do exhale from the *Sun*, and are dissipated again, like those that sublime from the *Earth*. For tho' the whole *Sun*, at some time may be altogether free from any *spots*; yet is he frequently so beset with them, that GASENDUS hath observed no less than 40 of them; yea, they sometimes increase to that bulk, as to be visible without a *Telescope*; which hapned not only at the time of CHARLEMAIN, but also of late years, when KEPLER took one of those *spots* to be the *Planet* of *Mercury*.

The Out-parts of the *Spots* are sometimes bright, and represent several *Colours*; when in the mean time their *Middle parts* continue still opaque.

This proceeds from the *Matter* of the *Sun* that surrounds these *spots*; for tho' probably all of them may at the beginning be of the same thickness, and equally resist the *Light*; yet it may so happen, that afterwards they may be more attenuated in the *Circumference*, than in the *midst*; and by this means the *Sun-beams* being refracted through these thin brims of the *spots*, do exhibit several *Colours*; whilst all this while, the middle of them continues opaque and impervious to the *Solar Rays*. Because the most *subtil Matter*, which is predominant in the *Sun*, and in every *fixt Star*, hath not force enough to transmit its own *Action*, because its strength is broken by meeting with the *soft parts* of *Matter*: Or, if by chance the *Heavenly Globuli*, being whirled about by the force of the *Matter* of the *fixt Element*, endeavour to withdraw from the *Center*, and to communicate the *Action* of *Light* to our *Eyes*; yet is not that impulse strong enough to affect the *Sense*, except it be accompanied with a continual pressure of the *Sun* and *fixt Stars*, such as may be sufficient to overcome this Reluctancy, and dispose it for the reception of the *Action* of *Light*.

These *Solar spots* are more commonly discerned about the *Ecliptick*, than towards the *Poles*, according to the unanimous Assertion of most *Astronomers*; some whereof have been so accurate in the description they have given of their progress, as to declare that these *spots* move about the *Rim* of the *Sun*, not in perfect parallel Lines to the *Ecliptick*, but with an inclination towards 3 *Degrees* and an half.

The Cause of this *Appearance* is, that tho' the *Particles*, whereof these *spots* be composed, have *Action* enough, when they proceed from the *Eclipticks* of other *Vortexes*, to pass through the *Poles* of the *Sun*, and to be carried towards its *Ecliptick*; yet when they are once mingled with the most *subtil Matter* of the *Sun*, not being able to comply with the most swift agitation thereof, are flung off towards the *Heaven*, where the motion is not so swift; as before hath been said concerning the *Scum*. Now the Reason why they are rather expell'd towards the *Ecliptick*, than towards the *Poles*, is this, because the new *Matter*, which

II.
These Spots
are Fumes
Proceeding
from the
Sun.

III.
Why sometimes the
outward
parts of
these Spots
be bright
and shining,
and the middle
parts dark.

IV.
The Spots
of the Sun
are more
frequently
perceived
about the
Ecliptick,
than about
the Poles.

Figure
16.

which continually enters through the *Poles* of the *Sun*, thrusts out the *striate Particles*, and all others that are easily entangled together, and drives them upwards. * For the better clearing of this, let us suppose 2 *Rivers* flowing from opposite *Points*, the one from *A* to *S*, and the other from *B* towards the same *S*; and that their *Streams* meeting at *S*; and driving each other forward, make a deep *Hole* or *Whirl-pool*, *d e f g*; where, after having performed several *Circulations*, they continue their *Course* towards *M* and *Y*. Besides, let us suppose that by this forceable meeting of these *Streams*, much *Froth* is produced, which swims on the top of the *Vortex S*, and follows the motion of the *Water*: We shall easily apprehend, that this *Froth* cannot tend to *A* or *B*, that is, towards the *Poles*; but after having taken some compasses in the said *Whirlpool*, will take its *Course* towards *M* and *Y*, that is, towards the *Ecliptick*.

V.
The Spots
of the
Sun are
sometimes
changed
into
Torches,
and Torches
sometimes
into Solar
Spots.

The *Spots* of the *Sun* are sometimes changed into *Torches*; and those *Parts* which before were dark and misty, appear bright and shining: And, on the contrary, these *Torches* are sometimes turned into *Spots*.

The cause of this Change is the *Ebullition* of the *Sun*, whereby it continually casts out some of its parts, and soon after swallows, or takes them in again. For *Spots* are turned into *Torches*, when the *Solar matter*, which flows about them, is raised above their *Rims*, and by exerting its force upon them, does produce that Action, which reaching our *Eyes*, produceth that which we call *Light*. For seeing that the *Matter* of the *Sun* is intercepted between the *spots* themselves, and the *surface* of the Neighbouring *Heaven*, the swiftness of the *motion* is increased, because of the narrowness of the *Space*; which therefore must render the *Light* of the *Sun* more intense. As we find by Experience in *Rivers*, whose swiftness is increased, and becomes more strong, the narrower the *Channel* is, or when strained by great *Stones*. But *Torches* are changed into *Spots*, and those which before were the more bright parts of the *Sun* become darkened, when that more subtil *Matter*, which lay upon their *surfaces*, is swallowed up by the *Sun*, into the room whereof, when abundance of *New matter* comes, whose *particles* cling together, they produce a close and dark *Body*.

VI.
What the
Reason is,
why the
Sun hath
for some
days been
without
Light.

Histories assure us, that the *Light* of the *Sun* hath been frequently intercepted to that degree, that his *Light* did not much exceed that of the *Moon*. Yea, what is more, *Histories* tell us, that in *PLINY*'s time, the *Sun* for 12 Days together was not to be found; and that when *CONSTANTINE* had his *Eyes* put out, it did not shine for 17 Days together, and that *Darkness* cover'd the *Earth* all that while.

I suppose, that no more proper Cause can be assign'd for this Obnubilation, than the *Spots* which at these several times did beset the *surface* of the *Sun*, and hinder the diffusion of his *Light*. For tho' these *spots*, at their first Gathering, be very soft and loose *Bodies*, which are able to break the force of the most subtil *matter*; yet the *Matter* of the *Suns* Substance, continually beating against them, makes them smooth and hard, whilst the other part of them, which is turned towards the *Heaven*, still continues soft and loose,

as before. And therefore they cannot without difficulty be dissolved, because the *Matter* of the *Sun* doth continually rush against the inside *surface* of them; but rather increase continually, as long as these their *Edges*, which are raised above the *surface* of the *Sun*, are not made hard by the constant pushing of the said *Matter*. And therefore whenever this happens, it cannot seem strange, that one and the same *spot* should so spread it self over the *surface* of the *Sun*, as to intercept the *Light* of it, not only for many Days, but also for some Months.

These *Spots* sometimes appear of an *Oval*, and sometimes of some other figure, when they move in the utmost Circumference of the *Suns* *Body*.

The Reason is, because there they must needs appear less, when their illuminated part is invisible to us, and the lesser dark part is only perceived by us; but the more they approach towards the middle of the *Sun's Round*, and in a right Line to our *Eye*, so much the greater and rounder do they appear to us. Another Reason also of their different Appearance, may be the various Configuration and Disposition they have amongst themselves, as when some of them happen to meet in the same Line of our Sight, and by this means do in part hide one another, for then they appear of a kind of *Oval figure*. And forasmuch as many of them do frequently thus meet together, and are afterwards separated again; it so happens, that some of them seem to us to be generated, and others again to be destroy'd or vanish; which then comes to pass, when *spots* of different *Magnitudes* and *Distance* (some of them moving more swiftly, and others more slowly) do hide one another; and when some of the lesser of them, and that are nearer to the *Sun*, are by degrees *Eclipsed*, and afterwards again uncover'd, and so appear, as before.

VII.
How these
Spots come
to appear
of divers
figures.

CHAP. XI.

Of Spots that appear in the Orb of the Moon.

Here be 2 sorts of *Spots* perceiv'd in the *Moon*, some are perpetual, and which from the beginning have appeared in it, as proceeding from the make and disposition of her *Parts*: And others *Temporary*, which only are about the *surface* of her *Body*, and after a short time vanish and disappear again. The *Perpetual spots*, do always appear of the same dark and dusky Colour; and which way soever they be posited, with respect to the *Sun*, do always retain the same degree of Obscurity, and are much darker than those *spots* that are temporary.

This *Phænomenon* proves, that there is a great affinity betwixt our *Earth* and the *Lunar Globe*, and that like *Bodies* are found in them both. For we cannot imagine these constant or perpetual *spots* to be any thing else, but *Seas* which are diffused over the *Body* of it. For it is evident, that the *Light* reflected from *Water*, is much weaker than that which is reflected from the *Earth*, or any other solid *matter*; as we may see in our *Sea*, which doth not appear of a white, but of blewish, or Sea-green Colour. We observe also,

I.
Of the
Perpetual
and Tem-
porary
Spots in
the Moon.

that *white things*, when moistned, do become more obscure, and draw towards a *black Colour*. Let but some *Water* be spilt upon a *Floor* (to make use of *GALILÆUS* his *Example*) and presently the moistned *Bricks* will appear of a *darker Colour* than the rest, because the *water* filling their *pores*, makes their *surfaces* plain and even; which consequently do unite the *Rays*, and direct them to one *Point* only. And seeing that fewer *Rays* are reflected from a *Convex surface*, than from one that is plain, the *Light* which from the *Moon* can be reflected to our *Eyes*, must be so inconsiderable in quantity and strength, as not to be so much as one 14000th part of her *Diameter*.

II.
What the Reason is of those bright parts which sometimes appear in the Moon.

The *Moon* has some parts which are much brighter than the rest, and which do so strongly affect our *Sight*, as that they seem to be very distant from one another. Whence *GASSENDUS* tells us, that about the 3d or 4th day after the *New Moon*, we may for the most part observe, beyond the lower point of her *Body*, at the distance of about a 27th part of her *Circumference*, a certain bright *Point*, and sometimes also a 2d and a 3d, at a greater distance, whilst the *Intervals* betwixt them continue still in *obscurity*.

These *Appearances* give us good ground to conclude, that there be *Mountains* in the *Moon*, seeing that with the assistance of a *Telescope*, the *Ridges* of several of them are perceived very bright, which cast a most thick *shadow*, and that greater or less, according as those *Eminencies* are more or less distant from the *Confines*, which separate the enlightened part of the *Moon* from the dark. For it is observed, that these *shadows* decrease, according as the *Illumination* is increased, until that they do altogether vanish away upon the diffusion of the *Light* over the whole *Hemisphere*. And after that the *Lunar Beams* are come to the other *Hemisphere*, the same *Ridges* or *Tops* of *Mountains* do appear again, and cast their *shadows*, but towards an opposite *Point*. Which *Appearances* afford us an incontestable *Proof*, that the *Moon* hath her *Mountains*, as well as our *Earth*, whose *Tops* are illustrated by the *Sun*, and shed a great *Light*, whilst in the mean time her lower and more depressed parts, continue obscure and dusky.

III.
Whence proceeds that appearance of a Face, which is seen in the Moon.

About the 6th day of the *Moon*, towards the Western part of it, there appears the *Face* of a *Man*, with a broad *Fore-head*, a crooked *Nose*, a wide *Mouth*, and *Eyes* deep sunk.

This *Appearance* is caused by several *Spots*, that are depressed between the foresaid *Prominences*. For seeing that the *Mountains* in the *Moon*, do far exceed ours in height, they accordingly project great *shadows*, which renders their *Intervals* dark and obscure, and makes them look like *spots* residing in those places. This we find by *Experience* in the *Mountainous* parts of the *Earth*, which are thick set with *Trees*, and therefore appear more dark than bare and open *Fields*; because the *Trees* make a great *shade*, and hinder the *Rays* from proceeding further. Thus forasmuch as not only *Rocks* and *Banks* are discover'd in the *Moon*, but also very high *Mountains*; the *shadows* which they cast, may be so ranged as to represent the *Fore-head*, *Nose*, *Mouth*, *Eyes*, and *Lips* of a *Man*, but very deformed: Seeing that

it cannot be question'd, but that the even or plain parts of the *Moon*, which lye between the *Mountains*, are dark and reflect no *Light* at all towards us; and that therefore the *spots*, which represent to us the parts of some deformed *Countenance*, do not proceed from the *Tops* of the *Mountains*, but must rather be attributed to their *Intervals*, between which the *shadows* are projected.

But if any one enquire further, how it comes to pass that when we behold the *Moon*, we seem to see the *Face* of a *Man*, with *Eyes*, *Nose*, *Mouth*, &c. when indeed there is no such thing there.

To this I answer, that no other Reason can be assign'd for this *Appearance*, save only that the *Footsteps* or *Traces* of a *human Countenance*, are so deeply imprest in our *Brain*, from our frequent, and almost continual beholding of the *Faces* of *Men*; that the *Animal spirits*, which have their *Rendevous* in the *Brain*, not being able to penetrate the other parts of it, because of their *Resistance*, are easily turned aside, by the direct *Light* of the *Moon* imprest upon them, and made to betake themselves to those *Traces*, to which the *Idea's* of a *human Face* are linked by *Nature*. And tho' others seem to behold in the *Moon*, a *Man standing*, or any other *Appearance*, this is only to be attributed to their *Imagination*, which having been strongly imprest by such like *Objects*, have some *Traces* left in it, which are easily open'd again, by any thing that hath the least resemblance with them.

The *Moon* increasing, being look'd upon through a *Telescope*, doth appear rugged and, as it were, with *Teeth* like a *Saw*; as if in the very confines of the *Luminous* part of it, there were some rugged and uneven *Bodies*, that did terminate that part of its *surface*.

The Reason is, because the *Sun* being then newly risen, and only darting his *Rays* side-ways, doth cast *shadows* towards the opposite part. And because this *Section* of the shadow is very unequal, because of the great variety and multiplicity of the *Mountains* against which the *Solar Rays* are reflected, the *Face* of the *Moon* must needs appear uneven and jagged.

No *spots* or *shadows* are discerned in the *Moon*, when she is at the *Full*; yea, those very parts which appear'd very black at the time of her *Conjunction*, do at the *Full Moon* appear most bright and refulgent.

The Reason is, because all the parts the *Moon* then discovers to us, are illuminated by the *Sun*, who being directly opposite to her, doth enlighten all her most abstruse parts: Or, if any of her parts, by reason of their bending downwards, continue unenlightned, the same are cover'd by some nearer Parts, which turned towards us and them, and so do not appear to us at that time. To which may be added, that those *Intervals* which before were shaded, do not only at the *Full Moon* receive the direct *Rays* of the *Sun*; but also the *Beams* which are reflected from the sides of the *Mountains*, by which *reflexion* all the parts of the *Moon* cannot but appear white and refulgent to our *Eyes*.

IV.
Why the Face of a Man, rather than any other figure, is perceived in the Moon.

V.
Why the Moon increasing, appears with Teeth like a Saw.

VI.
Why the Moon at the Full doth appear bright all over.

CHAP. XII.

Of Comets.

I.
Comets run
through
several
Regions of
the Hea-
vens.

Comets observe no certain Tract in the Heavens, but perform their Courses sometimes through this, and sometimes through another part of them. For some do first appear at the Sun's rising, others at his setting. The Comet which appeared in the Year 1585, was almost directly opposite to the Sun, and wanted but little of receiving his Rays directly: Whereas another that appeared in 1607, was first seen about the Bear, when the Sun was near the Winter Tropick.

The Cause of these Appearances will be evident to us, if we consider that Comets, are Stars cover'd with spots, and swallowed up of other Vortexes. Now, forasmuch as they may happen to fall into any Quarter of the Heavens, accordingly they may sometimes pass through one, and at other times through another part of the Heaven; neither is there any part through which they may not take their course at some time or other. The place therefore of the appearance of Comets, is very uncertain, seeing that they promiscuously may pass by the Stars of any Asterism. So that Comet which appeared in 1618, did seem to come forth from the Rays of the Rising-Sun; when as others have been seen to appear from under the Beams of the Setting-Sun.

II.
Why some
Comets
move to-
wards the
East, others
towards
the West.

Comets seem to move every day, from East to West about the Earth; because the Earth moves the quite contrary way. But yet forasmuch as their own proper motion is indeterminate, those which come from a Vortex, which is towards the East, supposing they can continue their motion, will move towards the West; and those which proceed from a Vortex towards the West, must consequently move towards the East; yet with this Circumstance, that when they have once taken their determination towards the East, or towards the West, their Course is every whit as exact as that of the Planets; for after having 2. or 3. times calculated their Diurnal motion, it is easie to compose an Ephemerides of their whole Course, and to know as perfectly the degrees of their swiftness and slowness, as we know all the degrees of Heaven, through which they are to take their progress, and their various Configurations with the Stars.

III.
Why the
Comets
vanish at
last.

From what hath been said, may be gather'd the Reason why a Comet at first appears greater, and afterwards continually decreaseth, until its total disappearance: For seeing that Comets receive their Light from the Sun, after that they are past out of our Vortex, they can no longer appear to our Eyes.

IV.
The Time
of the
Continu-
ance of
Comets, is
uncertain.

Comets have no time prefixt to their motion: For sometimes many years pass without the appearance of any of them; and at other times many are seen in one and the same year: As Historians tell us, that in the year 1618, there appeared no less than 3 or 4.

Forasmuch as Comets proceed from several Vortexes into ours, it is very difficult to determine, whether their Appearance be fortuitous and casual, or regulated and necessary: But howsoever it be, we are to consider it as fortuitous, because all the

Observations that have been made hitherto about this Matter, are not over exact. And if so be that Comets do never begin to appear in the Zodiack, it is without doubt, because the motion of our Vortex, which is very rapid in that part of it, makes their entrance that way more difficult, or, it may be, altogether impossible.

Comets do generally appear under the same Magnitude, inasmuch as that being beheld through a Telescope (if we will believe the Assertions of some) they do not appear greater, than when beheld without it.

The Reason is, because they are so far from us, that one and the same Comet may be perceived at the same time by several Spectators, tho' at a vast distance from one another, and that without any Parallax. So that they are probably concluded to be in that vast Space which is supposed to be betwixt Saturn and the fixt Stars. For the Comets are such vast Bodies, and are moved with such extraordinary swiftness, that they stand in need of that immense Space for the performing of their Courses; neither can any other places be assigned, wherein they can conveniently absolve them.

But how can it be, may some say, That Comets being beheld by Spectators with a vast Tract of the Earth between them, should exhibit no Parallax or variation of Aspect? This difficulty will be fully cleared by the Figure. For suppose we that some Luminous Body A, or F, placed in the lower part of Heaven, should be beheld by 2. Persons at a distance, D and B, at the same time; then will the Luminous Body A, which is seen by the Spectator D, appear over against the Luminous Body E; and the Luminous Body F, seen by the other, will appear over against the Luminous Body H. But the same Luminous Body A, when perceived by another Person at a distance B, will appear to him about the Luminous Body C. And the Luminous Body E, seen at the same time by the Person B, will be discover'd by him over against the Body G. And thus the Aspects of these 2. Bodies, A and F, according to their different situation, will produce a greater or less Parallax, as is C and E, or G and H. But if the Luminous Body be placed in the upper part of Heaven, about I; it will appear to both Persons, at a distance from each other, in the same place, that is, over against the Luminous Body K.

Comets, after a few Months or Days, do disappear and vanish. And therefore PLINY determines their longest appearance to 185 Days: Seeing that which was seen in Nero's time, and was lookt to be of the longest continuance of any other, was conspicuous only the time of 6 Months, tho' in all that time it scarce run through the one half of Heaven.

The Reason whereof is, because Comets, by passing from one Vortex to another, are driven towards the Circumference of them, because of their solidity: And tho' they every where retain the same degree of Celerity; yet because they have more Agitation, than to be stopt by the Matter of the Vortex, through which they pass, they slip into a Neighbouring Vortex, much like a Ship, which being carried contrary to the Stream of a River, doth in some degree comply with the motion of the River, but is at last driven to the Shoar.

Thus

V.
Why Co-
mets do
generally
appear
under the
same Mag-
nitude.

VI.
Comets
being in
the highest
Heavens,
cannot
have any
Parallax.

Figure
17.

VII.
Why the
Comets do
vanish
after a
few Months
appearance.

Thus a *Comet* Courting it sometimes through this, and sometimes through another part of *Heaven*, doth continually keep it self at a distance from the *Center* of the *Heaven*, wandering only in the *Circumference* of it; and so by this means it comes to leave our *Heaven* within a few *Days* or *Months*, and pass into others which are invisible to us. Wherefore, if we measure the *Space* which the *Comets* run through, we shall seldom perceive it to reach the half of a *Circle*, and that most frequently it doth not exceed the quarter of one. And if at any time it happens, that their *Appearance* is continued 4 *Months*, or longer, this is because they enter into our *Vortex*, near the *Poles* of it, where they find the *Matter* less agitated.

VIII.
Comets
move much
more slowly
towards
the End of
their
Course,
than at
the begin-
ning of it.

Comets about the beginning of their *Appearance* are most swiftly moved, and but slowly towards the end of it; according to the account which *Astronomers* give us of that which appeared in 1572; which at the beginning of its motion, proceeded 5 *Degrees* every day, and towards the End thereof scarcely *Half a Degree*.

The Reason hereof must be fetched from the distance of the *Comets*; for tho' *Comets* by passing through the *Extremities* or utmost parts of the *Vortexes*, do always keep the same degree of swiftness; yet because at first they have run a good way of their *Course* before we see them, by reason of the *Matter* they bring along with them, which too much refracts the *Rays of Light*; and then do by little and little move towards other *Vortexes*, and withdraw from our sight, therefore their *Courses* appear more slow towards the end of them. After the same manner as when we see a *Traveller*, passing on his way with the same pace, as long as he is not at any considerable distance from us, we perceive no difference in his gate, until he be come to a greater distance, when he appears to us to move more slowly; not because of his moving so indeed, but because of his greater distance from us.

IX.
The Motion
of Comets
appears
swifter in
the middle
of their
motion.

Tho' *Comets* move more swiftly, when they first enter into any *Vortex*, than after that they have been there for some time; yet is the midst of their *Course* swifter than any other parts of it; because being then in their *Perigæum*, or place nearest to the *Earth*, they are also in those parts of the *Line* they describe, which are nearest to the *Earth*: Whereas, when they are at the beginning or end of their *Course*, they are about those parts of the same *Line*, which are the most remote from us. To this we must add, that when a *Comet* at the same time is in his *Perigæum*, and his opposition with the *Sun*, his motion must appear much more swift, because he is then nearer to us by the whole quantity of the *Excentrick* of the *Earth*.

X.
What is
the Cause
of the
Tail and
Beard of
Comets.

Comets commonly shed *Hairs* from them, especially on that side which is opposite to the *Sun*: But after a various manner; for some drag a *Tail* after them, others have a long *Beard*, others represent a *Rose*, by having these *Hairs* scatter'd round them.

This variety proceeds from the different *Heavenly Globuli*, that are found in our *Heaven*. For we suppose those that are near to the *Center* of our *Vortex* to be less, but that they increase by

degrees, as they draw nearer to the Orb of *Saturn*; which after they have once past, they are all of them equal, and whirl'd about with the same degree of swiftness. Forasmuch therefore as *Comets* are carried in the utmost parts of the *Vortex*, and borrow all the *Light* they reflect to us from the *Sun*, it follows, that those *Beams of Light*, which are communicated by the greater of those *Globuli*, by that time they come to the lesser, do not only pass according to *Right Lines*, by which, as being the chiefest, the *Head* of the *Comet* is seen by us, but are also refracted and dispersed side-ways. As if a *Vessel* should be so fill'd with *Bullets*, as that the great ones did lye upon the lesser, we shall find, that upon boring a *Hole* at the bottom of the *Vessel*, the greater *Bullets* lying at the top, must in their descent press upon more of the lesser, and drive them down to *Right Lines*. And the same thing is observed in *Comets*: For seeing that the *Sun* is much about in the midst between the *Comet* and the *Earth*, his *Rays* beating against the *Comet*, and scatter'd on every side of it, do produce the *Hair* of it: But when the *Earth* withdraws from the *Right Line*, which joyns the *Centers* of the *Sun* and a *Comet*, then the *Beams* of the *Sun* which are reflected towards us, do represent the *Body* or *Head* of the *Comet*; and those which are diffused towards the *Edges* of it, do represent its *Beard* or *Tail*. Which are called by either of their Names, as they either go before, or follow the *Body* of it.

The *Figure* will fully clear this Point. Let the *Sun* be S, the *Circle* through which the *Earth* runs in a *Years* time, 2, 3, 4, 5, according to the order of the said *Ciphers*. The term or limit from whence the *Globuli* begin to grow less and less, D E F G, and the *Comet* in our *Heaven* C. It is apparent that the *Rays* of the *Sun* darted against this *Comet*, towards all the parts of the *Circle* D E F G H, are in such a manner reflected thence, that those that fall perpendicularly upon F, do most of them tend towards 3; but some of them are scatter'd this way and that way; and those which fall obliquely upon G, do not only tend directly towards 4; but are in part refracted towards 3: And lastly, that those which fall upon H, do not reach directly to the *Circle* of the *Earth* 2 3 4 5, but being reflected, tend towards 4 and 5. Whence it is evident, that when the *Earth* is in the part 3 of her Orb, the *Comet* C will appear to those that view it from thence, with *Hair* scatter'd on all sides of it, which sort of *Comets* are commonly called *Roses*: For the *Rays* that come directly from the *Comet* C, to 3, do represent the *Head* of it; and the weaker, which proceed from E and G, towards 3, do afford the appearance of its *Hair*. But if the *Earth* be at 4, then the same *Comet* will be perceived by the *strait Rays* C G 4, and its *Tail* will appear directed only to one part, by the *Rays* that are reflected from H, and other places between G and H, towards 4. And in like manner, when the *Earth* is at 2, the *Comet* will be perceived by means of the direct *Rays* C E 2, and the *Hair* of it by the oblique *Rays*, which are plac'd between C E 2, and C D 2. Neither will there be any difference, save that when the *Spectator* is placed at 2, the *Comet* will appear in the Morning, with

XI.
How Co-
mets come
to appear
with Tail,
Hair, or
Beams like
Roses.

Figure 27.
in the In-
stitutions.

CHAP. XIII.

Of the Productions of the Stars.

with its *Hair* going before it, but to the *Spectator* placed at 4, the *Comet* will appear in the Evening, with a *Tail* trailing after it.

XII. Why none of these appearances are ever perceived in the Planets.

The Reason why the *Planets* never appear with *Tails*, *Beards*, or *Hair* scattered round them like *Comets*, is because the *particles* of the 2^d Element, which encompasseth them, are not big enough to make *Beams* that enlarge and divide themselves into many others; whereas those that are about the *Comets*, are always big enough for that purpose.

XIII. Whether Comets presage future events.

Comets are commonly look'd upon as the fore-runners of great *Calamities*, and are supposed to presage *Storms* and *Tempestuous Weather*, *Devastations*, *Famine*, *Wars*, *Death of Princes*, *Plague*. Thus the *Comet* that appeared in *VESPASIAN* time, is said to have presaged his *Death*; others the taking of *Rome* by *ALARICUS*; the Murder of the Emperour *MAURICE*, and destruction of *MAHOMET*; the Death of *CHARLEMAIN*; the irruption of the *TARTARS* into *Silesia*, and the cutting off of the *Inhabitants Ears*.

Such Stories as these are common amongst the vulgar, and believed also by many who think themselves much wiser than their Neighbours. But if we examine the matter, we shall find that the appearance of these Stars had no connexion at all with the things that hapned soon after their appearance. For if *Comets* be the signs of *Wars*, the death of *Princes*, &c. Why do these ever happen without the foregoing presages? Why do *Kings* die, *Famine* and *Plague* prevail, when no *Comets* at all have discovered themselves to give warning of these accidents to the *World*? True it is, that these events are sometimes ushered in by *Comets*, but more frequently happen without them.

Moreover, seeing that *Comets* pass about the *Earth*, how is it that they foretell *Overthrow* and *Destruction* to some, *Success* and *Victory* to others? Probably indeed we might be induced to own this power in *Comets*, if *Kings* only died when they appeared; if they could distinguish between persons, or if they only aspect *Great-Men*. But since we always find the *Funerals* of *Princes* and *Great-Men*, accompanied with so many thousand of vulgar *Exequies*, have we not great reason to conclude, that they have no greater force or influence upon the former, than upon these latter?

XIV. The Affairs of Men are covered with great darkness.

But some Body will say; it is certain that these kind of *Stars* are sometimes sent by God to denounce some calamity or other to the *World*. Be it so, for I will not deny it; but by what Argument can it be proved, that the appearance of a *Comet* is to denounce this or the other particular event, rather than another? Has *G O D* ever by Revelation made known to us, that when a *Comet* moves towards the *West*, it denotes danger from things Foreign and without; and when to the *East*, danger from within? It is sure enough, that the *Comets* have no Power over us, and that it is only our *Folly* or *Ignorance* that makes us afraid of them.

IT hath hitherto been the common belief of most Men, that the *Stars* govern these inferior things; and by an universally diffused *Virtue*, preside over *Human Affairs*. Hence it is that they have attributed Heat to *Mars*, Cold to *Mercury*, Moisture to the *Moon*, as supposing their Dominion chiefly to consist in these qualities, and that they impart these to all their inferior *Subjects*. Therefore it is that they call the *Sun*, the Parent of the *Universe*, and the Great Artificer of all *Natural Works*; because they find that his presence imparts *Life* and *Vigour* to all *Natural Things*, as his absence, on the contrary, is the cause of their *failing*, *wasting* and *Death*.

Some Fancy Influences in the *Sun*, by which he concurs to the production of all *sublunary things*. But would they diligently give heed to the *Sun's Action*, they would find him to have no other but that of *Illumination*; or if they meet with any other, that they are reducible to it, as to their original. For that the *Sun* doth *heat*, *dry* and *burn* Bodies, proceeds from this Act of *Illumination*, which produceth these various effects according to the different disposition of the *Subjects*.

If any one say that *Cold* and *Moisture*, where-with *Bodies* are affected, cannot be derived from the *Sun*.

I Answer, That these also by accident do proceed from the *Sun*; forasmuch as during his absence, the *moisture* is no more discust and attenuated, and therefore the *Vapours*, either by their abundance, or by supervening *Cold*, become condensed, and moisten.

The *Sun* is the Cause of the *Tempestuous* and *Fair Weather*; and therefore when he is about the midst of *Sagittary*, upon the dissolution of those *humours* which before were bound up, and the *Earth* being watered with them, he produceth fruitful *Western Winds*: He stirs up the forces of the *Pleiades* and *Hyades* in *Taurus*; those of the *Kids* towards the *North*; those of his Neighbour *Orion* towards the *South*; and of *Arcturus* over against him, which stir up *Southern blasts*, and for some days together, do moisten with *Rains* the sown *Seeds*.

These and the like effects do not proceed from the *Sun*, as from a *special Cause*, but only as from a *General*, who diffusing his *Rays* every where, and promiscuously illuminating all *Bodies*, is not determined more to this effect, than to another. But if the *Sun* produce *stormy Weather* in one part of the *Earth*, and *Fair* in another, this is not so much to be attributed to him, as to the *situation* and *disposition* of the several parts of the *Earth*, which receiving his *Beams* after a different manner, are differently affected by them. For that we, for instance, have a pleasant *Summer*, and that our *Antipodes*, at the same time, suffer an unpleasant and sluggish *Winter Season*, doth depend on the *Sun*, who with a constant and even Course runs through the *Zodiack*, and uniformly diffuseth his *heat*. Who will say that the *Sun* is the Cause of *Tempests* and *Fair Weather*; when at the same time, he is the same on this side, or beyond the *Equator*? The reason therefore why

I. How the Sun is said to be the Author of the works of Nature.

II. How the Sun may be said to be the Cause of moisture and cold.

III. How the Sun produceth fair weather and tempestuous.

the *Sun* doth more copiously impart his *Light* and *Heat*, when it is *Summer* with us, is to be imputed to the *situation* of the *Earth*, that we tread upon, and which makes the difference between us and the *Antipodes*, with whom it is *Winter*; but not all to the *Sun*, to whom it is meerly accidentary, that they are *cold*, whilst we have *heat*, or who darts his *Beams* obliquely upon them, whilst he is perpendicular to us.

IV.
In what
sense the
Stars are
said to be
for Signs
and Seasons

Neither doth it contradict any thing that we have said, what the *Scripture* declares concerning the *Sun*, *Moon* and *Stars*, that they were to be for *Signs and Seasons*, and for *Days and Years*. Because these things are no otherwise signified by the *Stars*, than by the *Swallows*, who by their coming and going, do preface the *Spring* and *Winter*; or as *Rainbows*, *Lightning*, *Darkness* and other changes of the *Air*, do indicate *Showers*, *Thunder* or *Fair Weather*. For as *Swallows* are not the Cause of the *Spring*, nor the *Rainbow* of *Fair Weather*, but only signs of either of them: So neither is the *Dog-Star* a cause of the great *Heats* we have at the latter end of *Summer*, but only a sign of the time wherein they happen. As shall be declared hereafter.

V.
Whether
the Moon
hath any
Dominion
over Sublu-
nary things.

The *Moon* contributes very much to the changes we have here below, for she not only raiseth violent *Winds*, excites *Storms*, and reduceth condensed *Vapours* into *Rain*: but moreover doth make *Seeds* to grow, and ripens the *Fruits* of the *Earth*, and encreaseth or lesseneth moisture, according as she encreaseth, or is in the wane.

Tho' all these things pass with the most of People for indubitable, yet we have good reason to affirm, that they are taken up without sufficient ground or reason; because *Storms* are raised, *Showers* moisten the *Earth*, and *Plants* encrease and ripen, as well when she is opposite to the *Sun*, as when she is in her first, or last Quarter; except we should say that she hath the power by the weak light she draws from the *Sun*, of moving or stirring those *humours*, which she is not able to discuss, and therefore is said to foment and encrease them. But let that *virtue* be what it will, sure it is that it cannot with any reason be ascribed to her, seeing that it belongs only to the *Sun* as a General Cause; who by his *Beams* produceth all the vicissitudes of *times* and *things*, which we see here on *Earth*. Hence are those Rules of *Astrologers*, that *Millet* should be sown in *April*, whilst the *Sun* is in *Taurus*; and *Wheat* in *October*, when the *Sun* riseth together with *Scorpius*, and when the *Pleiades* sink out of sight, as the same is elegantly described by *Virgil*, in the first Book of his *Georgicks*.

*And Millet then your Annual care awakes,
When Taurus Golden-borns open the Year;
And Syrius leaves to other Stars the Sphear.
But if for Wheat and stronger Corn, thy ground
Thou exercise, and but a Crop propound;
First let the Eastern Pleiades go down,
And the bright Star of Ariadnes Crown:
Commit due Seed to Furrows then, and here
Trust Earth with hope of the ensuing year.*

Hence it is that the Poets call *Orion*, *Stormy* or *Tempestuous*; the *Vergilæ* or *Pleiades*, *Showery* or *Cloudy*, because upon their appearance the *Seas* are troubled with *Storms*, and the *Earth* with

Rainy and *Cloudy Weather*. I do not deny but that the *Stars* may be said to be the *Signs* of changes of *weather* and *seasons*; but by no means the *Causes* of them, as if by their Influence and Activity *Plants* did grow, and attain their Maturity; but only point out those times, wherein the *Sun* is more favourable to the growth of *Corn*, or when the *Sea* is most subject to *Storms*.

The *Dog-star* excites extream heats, and is sometimes so malignant, as to produce dangerous and Epidemical Diseases.

But this event is to be resolved as the former; for this intense *Heat* doth not proceed from the *Dog-star*, as if there were any virtue in him, to cause, and excite some extream hot *Spirits*, proper to inflame and destroy the healthful temper of mens *Bodies*: But because this *Star* doth arise at that time, when the *Sun* by his nearness to the *Earth*, doth very much dry up its moisture, and draw forth those exhalations, which infecting the *Air* first of all, do afterwards communicate the same corruption to *Bodies*. Hence it is that the *Air* at *Rome* is at that time counted very unwholesome, because the Country thereabouts abounds with many *Caves* and *Holes*, whence the *Sun* raiseth many exhalations that are very prejudicial to health. But it is evident, that these effects cannot be attributed to the *Dog-star*, because that *Constellation*, when the *Heat* is at the height, is not advancing towards our vertical point, but withdrawing towards that of our *Antipodes*, and therefore ought rather to affect them, than us. For this is common to all *Stars* and *Constellations*, that they affect most those parts of the *Earth*, on which they dart their more direct *Rays*. Which since it doth not happen in the *Dog-star*, and that our *Antipodes*, at that time, are oppressed with Cold, when our Climate is scorcht with Heat; we may safely conclude, that the *Heats* we are sensible of, at that time, do not proceed from the *Dog-star*, but that there is a quite different Principle to be assigned for our heat.

How absurd it is to attribute Acute Diseases to the *Dog-star*, is evident from hence, because whereas that *Constellation* about 2000 years since, did arise about 23 or 24 days after the *Solstice*, that is, about the 7th of *July*, of our Style; it is still supposed to rise at the same time; whereas indeed the *Dog-star* doth not rise now till a month after, by reason of the motion of the *Fixed Stars* towards the *East*, according to the order of the *Signs*. And notwithstanding Acute Diseases, Fevers, &c. are commonly attributed to the former term, beginning at the 7th day of *July*. But who can believe that those extream Heats, we are sensible of in *July*, will ever be translated to *January*? When yet it is most certain, that after 10000 Years, if the *World* continue so long, the *Dog-star* will arise about that time.

The Virtue and Efficacy of the Planets are proved by certain Experiments; as that some of them influence Cold, others Heat; some under such an Aspect communicate Moisture, and under another Drought. Whence is that of *PLINY*, When the Grass and Herbs are grown, and that they stand in need of more Moisture, whereby they may arrive to their full growth and perfection; the *Sun* by entering the *Constellation* of *Cancer*, doth furnish and supply the same.

VI.
The Dog-
star hath
no virtue
for the pro-
ducing of
Heat or
Diseases.

VII.
It is absurd
to ascribe
acute Dis-
eases to the
Dog-star.

VIII.
The Planets
do not con-
tribute to
the Moi-
sture or
Drought of
Sublunary
Bodies.

This

This also, in a good Sense, may be said to be false and erroneous; for seeing that all the *Planets*, act only by the light which they borrow from the *Sun*, and that they reflect nothing but it, there can no diversity of *Effects* be infer'd from the variation of it. For all that can be gathered from their Conjunction with the *Sun*, is only this, that the *Air* is Hot in *Summer*, and Cold in *Winter*. But as to what Weather it will be the next Year, when the *Sun* shall enter this or the other *House*; when the *Dog-star* shall arise; or when *Arcturus* shall set; whether the *Winds* will be boisterous; whether we shall have a hot *Summer*, cannot with any certainty be known from any preface that can be taken from the *Stars*; since it frequently happens that the very Seasons of the Year are confounded, so as that we have cold *Summers*, clear and mild *Winters*, a hot *Spring*, and *Winter-like Autumns*. For the *World* is not governed in such an exact and settled order, but that great alterations happen in the Seasons of it, and make it look as if it were governed by hap and chance.

Conclude we therefore, that no *Stars*, besides the *Sun*, who acts only by his *Light* and *Heat*, have any influence on things here below: And that therefore it is a vain thing for *Astrologers* to predict *Wind* or *Rain* from the Position or Aspects of the *Moon*, or from the same indication to prescribe the taking of a *Potion*, or *Blood-letting*, or to determine that it will be good or bad *Sailing Weather*; that *Trees* are to be planted, *Flowers* and *Herbs* watered in the encrease of the *Moon*. From all which notions, I question not but men will be delivered, by considering their vanity, and that they are only grounded on such suppositions, the truth whereof can never be proved.

CHAP. XIV.

Of the Predictions of Astrologers.

IT is a thing notorious, that *THALES* the *Philosopher*, was skilful in *Astronomy* and *Astrology*; and that from this Knowledge of his, he was assured of a Dearth of *Oyl*, which came to pass accordingly.

Tho' this be a Story, commonly avouched by *Astrologers*, to maintain the *Glory* of their *Science*, yet it may easily be made out, that he did not conjecture this from any Rules or Precepts of *Astrology*, but from his continual Study of Nature. For being a great *Natural Philosopher*, and being well acquainted with the virtue and efficacy of *Water* (which he maintained to be the *Principle* of all things) he could not be ignorant what *Fruits* stood in most need of *moisture*, and how much they were beholden to *Rain* for their growth and increase; and in what *season* of the *Year* they thrive best. All these things he might easily know without the *Precepts* of *Astrology*, they being such, as no *man*, skill'd in *Natural Philosophy*, can be ignorant of. But if they will needs have it, that *Thales* foreknew this by his Skill in *Astrology*, why do not they do as much, who pretend to be so well vers'd in the said *Art*? How comes it to pass that they are always *poor*, if they, by their Skill, have the same opportunities of enriching themselves which *Thales* had? But the case is plain, that they themselves cannot trust the Truth of

their own *Principles*, and are afraid of spoiling their Credit, by a too peremptory assertion of any thing that is built on them.

And not without good Reason: For 1st, They are not certain of the Nature and Virtue, even of those *Stars* that are most known. 2^{dly}. Because the Nature and Virtues of most of the *Stars* are utterly unknown to them; which unknown Virtues may variously change and alter the operations and effects of those *Stars* that are known. 3^{dly}. Because they can give no Reason, why a Figure erected for a Childs *Nativity*, to guess at his *Fate*, *Manners*, &c. must be taken from the time of his *Birth*, rather than from that of his *Conception*. 4^{thly}. Forasmuch as the Aspects of the *Stars* are greatly changed in a small moment of time, by reason of the incredible swiftness of their motion; how will any *Mother* or *Midwife* be able so exactly to determine the very just moment of the Childs *Birth*, so as to make the *Astrologers* Judgment true and certain, which cannot be pretended, except the exact point of time be given him. Besides, 5^{thly}. We find that those persons, who were born and conceived at the same moment of time, are found to have different *Natures*, *Manners* and *Destinies*: And that persons of both *Sexes*, of all *Ages*, and born under several Aspects of the *Planets*, and in different *Countries*, do perish at the same moment of time by *Earthquakes*, falling of *Houses*, taking of *Cities* or *Shipwrecks*. 6^{thly}. I would demand of these Men that are for Influences, whether *Discipline*, *Learning* and *Good Education*, or *Divine Providence* it self have no influence upon the Manners of men, to oppose and countermine this force and efficacy of the *Stars*?

Probably it was for these, or the like reasons, that *Astrologers*, *Magicians* and *Diviners*, were by a most severe Edict of the Emperor *Tiberius*, banished out of *Rome*, and all *Italy*, according to the account *Dion* gives us, *Lib.* 57.

Neither is it of any consideration in this case, that the *Ancient Poets* have put the names of *Bears*, *Lions*, *Perseus*, *Hercules*, &c. upon the *Constellations*; forasmuch as this was not done by them, because they supposed them to have any particular influence upon *Bears*, *Lions*, &c. but only in commemoration of some strange and wonderful accidents, or to celebrate the memory of some of their *Antient Heroes*, and their *Atch* events: In the same manner as *GALILÆUS* not long since, gave the name of the *Medicean Stars*, to the secondary *Planets* by him discovered about *Jupiter*; not because of any *Medicinal Virtue* he supposed to be in them, but in honour to the *Great Duke of Tuscany*, whose Name is *de Medicis*.

Many have had the time of their death foretold to them: Thus *SENECA* makes mention of a certain person, who being told by an *Astrologer*, that his *Death* was at hand, went home, and 2 days after died.

To which I answer, that this effect doth not prove the Truth of the Prediction; for tho' a *Prognostication* be never so vain and ungrounded, yet it may strike such a fear into the person to whom it is declared, as may cause his *Death* to follow thereupon: For a person in this Case, finding himself altered and discomposed with the fright, he presently imagines, that this Illness is the sure fore-

II.
Reasons
that prove
Judicial
Astrology to
be vain
and false.

III.
Whence the
Stars took
their
Names.

IV.
Many have
had their
Death fore-
told them
by Astrolo-
gers, but
without
any cer-
tainty.

IX.
The Stars
have no
Power over
Sublunary
things.

I.
Whether
Thales, by
the help of
Astrology,
foretold the
Dearth of
Oyl.

runner of his *Death*, and so kills himself by the strength of his Imagination. How many have by this means hastned their own ends, and have died for fear of *Death*? For it is not always the greatness of the Evil we suffer that troubles or torments us, but the conceit we have taken of it. Who doth not deride *ARCHELAUS*, who, according to what *Seneca* tells us of him, at the time when the *Sun* suffered an *Eclipse*, commanded his Palace to be shut up, and had his *Sons Hair* cut off; which was never done but in sign and token of the extreamest Grief and Calamity? Or who would not deride the superstition of the *Thebans*, who shouted, beat upon *Bra's Instruments*, and rung *Bells*, to rescue the *Moon*, whom they supposed that some *Witches* were, by their *Charms*, about to pull down from her station in *Heaven*? For people commonly are not so much troubled with things, as with the *Opinions* and *Imaginations* they have taken up concerning them.

V.
Various things seem to have been truly foretold by some Astrologers.

But some will say, that at least it cannot be denied, but that *P. Nigidius*, the *Astrologer*, foretold to *Augustus*, that he should be Lord of the *Earth*, and the Successor of *Julius Caesar*. *Scribonius* declared concerning *Tiberius*, when he was yet an *Infant*, lying in his *Cradle*, that he should come to the *Empire*; and after having overcome manifold difficulties, should be the Sovereign of the *World*. *Largius Proculus* determined the day of *Domitians* Death; and *Ascletrarius* fixt the manner of it; who being thereupon demanded by the *Emperour*, whether he knew what kind of death he should die himself, answered that he should be torn to pieces by *Dogs*: Whereupon the *Emperor* to prove him a *Liar*, and to expose the vanity and groundlessness of his Predictions, commanded him presently to be burnt; which being put in Execution, as he was burning, a suddain storm of *Rain* falling, extinguish'd the *Fire*, whereupon the *Dogs* falling upon the half-burnt Body pulled it to pieces and devoured it.

To all which I Answer, 1st. That we have ground to question the Truth of many of these Relations; not that I would make the veracity of all *Historians* doubtful, or suppose them to have inserted Lies, on set purpose into their Relations; but because I conceive them to have been too apt to give credit to the Report and Talk of the Common People, especially about those Rumours that were spread abroad concerning the *Birth* or *Death* of their *Kings* and *Emperors*. 2^{dly}. It is a thing notorious beyond dispute, that many of them did by all means endeavour to please and flatter their *Princes*; which they had no better way to do, than by inventing some things they knew would be grateful and acceptable to them; as by shewing that they had been by *GOD* elected and appointed to the *Government*; that they should be prosperous in their *Reign*, and enjoy long *Life*, and lasting felicity.

But that I may not seem to be too injurious to *Historians*, let *SENECA* speak instead of me; who living at the same time with them, was fully acquainted with their Manners and Temper. Neither, saith he, need we take much pains to invalidate the Authority of *Ephorus*: For, to say no more, he is an *Historian*: And how many are there of these, who hunt for praise, by relating of things

strange and incredible; and stir up their Readers Appetite (who should they relate common and ordinary things only, would never think them worth the reading) with some prodigy or miracle? Some of them are credulous, others are negligent; some of them are overtaken with Lies; others are pleased and delighted with them. Some do not take the care they ought, to avoid all falsities; and others desire them; and this may be said in common of them all, who think their Work will never be approved of, or become Popular, except it have a sprinkling of Lies. And as for *Ephorus*, it is well enough known, that he is not a Writer of the most Religious Veracity, but that he is often deceived himself, and as oft deceives others.

Indeed it may easily be proved, that many *Historians*, besides *EPHORUS*, have both deceived others, and been deceived themselves, in their Relations concerning *Augustus*. For seeing that *Augustus* could not be posselt of the *Empire*, till after the Death of *Caesar* and *Pompey*, of whom the *Chaldeans* had foretold, that they should die, not by violent Deaths, the one in the *Senate*, the other in *Egypt*, but in their own Houses, and full of Years and Glory; how can we give credit to them, seeing they pronounce things contrary? And whilst they stumble upon one Truth, pronounce many Lies, and are deceived in all the rest?

But they will further urge the instance of *Ascletrarius*, who precisely told the manner of *Domitians* Death, and his own too; Whence had he this, but from the Stars?

I will not here alledge the Opinion of several Authors, who have look'd upon this whole story of *Ascletrarius*, as one of those Fables that run amongst the Vulgar. But shall only hint this one thing, that *Ascletrarius* might foreknow the Death of *Domitian*, without any assistance from his skill in *Astrology*, and that by very certain and unerring signs. First. For that *Tyrants* are hated by all men, and that few of them die in their Beds. 2^{dly}. He knew that many did lie in wait for *Domitian* to kill him, and that he was every way surrounded with Enemies. But as to what he foretold of himself, that he should be torn to pieces by *Dogs*, this he could not foreknow, but by near guessing at a venture; and therefore it seems most probable, that this was only a fiction superadded by the Common People, to make the Story look more strange and wonderful; seeing that the most skillfull *Astrologers* do not extend their Predictions beyond Death; and therefore it is probable that *Ascletrarius* supposed not that his dead Carcass should be devoured by *Dogs*, but that *Domitian* would have exposed it to be torn to pieces alive by *Dogs*, for a punishment of this Boldness, in foretelling his *Death*. And if so, it is apparent he was mistaken, and that the Predictions of *Astrologers* are vain and uncertain; or if any thing they prognosticate comes to pass, it is only by chance and conjecture. Such were the foolish Prognostications of a certain *Astrologer*, who from the condition of the weather on *New-years-day*, would determine the Fate and State of the whole following Year. But who is so senseless as to believe such stuff as this, or to amuse himself with groundless Conceits and Imaginations?

VI.
How Ascletrarius might foreknow Domitians Death.





The Fourth Part

OF THE

H I S T O R Y

O F

N A T U R E.

O F

E A R T H, W A T E R,

F I R E and A I R.

CHAP. I.

Of the Globe of Earth.

I.
Why the
Earth, as
containing
the Water,
is called a
Terraque-
ous Globe.

THE *Earth*, forasmuch as it contains in its Cavities the *Waters*, and together with them constitutes one *Globe*, is called the *Terraqueous Globe*.

For when we take a *Voyage* by *Sea*, sailing in the *Atlantick Ocean*, and passing through the *Magellan Straits*, towards the *South Sea*, and so on to the *East* and *Aethiopic Seas*, we find that all these *Seas* are encompassed with *Shores*. And in like manner, when we travel by *Land*, we shall find the *Land* bounded, on one side with the *Atlantick* and *Aethiopic Seas*, and on the other with the *South Seas*; and again, this way with the *Eastern* and *Arabian*; and that way with the *Tartarian*, *Atlantick* and *Aethiopic Seas*.

II.
The Earth
is but a
Point, com-
pared with
the vast
extent of
Heaven.

Tho' the *Earth* be of that vast extent, that its compass is of about 7000 *French Leagues*; or according to the later investigation of *WILLOBRORDUS SNELLIUS*, of 24624 *Miles*: Yet if we will believe *Astronomers*, it is no more than a *Point*, compared with the vast *Circumference of Heaven*.

Neither is this Assertion of theirs without ground: For so great is the distance betwixt the *Earth* and the fixt *Stars*, that it cannot be certainly determined, as exceeding all Calculation; and can scarcely be apprehended by our *Imagination*. The distance of the *Planets* may be discerned by their *Parallax*, or that variation of Aspect they afford to several *Spectators* in distant places; but the *Fixt Stars* are at so prodigious a distance, that no *Parallax* is to be found in the beholding of them, and the *Semidiameter* of the *Earth*, with relation to them, is as nothing. So that if some one of us should be supposed to continue in the

place of the *Earth*, whilst it was carried up towards *Heaven*; there is no question, but at its first rising, it would shew like a vast *Globe*; but as it mounted higher, would still decrease to our sight; till being got up as high as *Jupiter*, it would appear no bigger than one of the lesser *Stars*; and rising higher towards the *Fixt Stars*, would become invisible to us. And therefore the *Earth* which contains so many *Seas*, so many *Kingdoms*, so many *Islands*, yet is no more than a point, with respect to the *Heavens*. Yea, when compared to our *Vortex*, which hath the *Sun* in its *Center*, we shall find it so inconsiderable, that they who make *Sundials*, suppose the top of the *Pins* of them to be placed in the *center* of the *Earth*, whence they cast their *shadows* upon the *surface* of it; as if the difference were so small, that it comes to the same thing, whether they cast their *shadows* from the *Center*, or the *surface* of it, the distance being so very inconsiderable in comparison to the *Sun's* distance.

This may give us an estimate of the folly of Men, who for one point of *Earth*, wage so many *Bloody Wars*, yea, for the 1000th or 100000th part of it. This forsooth, as *PLINY* saith, is the matter of our *Glory*. Here we enjoy our *Honour*; here we exercise our *Dominion*; here we have our *Riches* and *Possessions*; here mankind continually *Bustles*, *Toyls* and *Turmoyls* it self; here we wage *Wars*, and soak the *Earth* with one anothers *Blood*; and our *Swords* destroy our own kind. But not to speak now of the publick feuds, and fury of whole *Nations* against each other: Here it is that we endeavour to lay one clod of *Earth* to another; and after having purchased all the poor pittances of our *Neighbours* about us, what a brave purchase have we made after all? And what great Reason have we to boast in being *Possessors* of not so much as the thousand thousandth part of a point? But this is to sing a Song to a *Deaf-man*; return we therefore to our *Earth*.

III.
How vain
Men are,
that make
such pos-
sibilities
and fight-
ing about a
filly point
of *Earth*.

IV.
How the
Earth
hangs
pois'd in
the Air,
without
any thing
to support
it.

The Earth hangs in the midst of Heaven, without any Pillars to uphold it; and, as if it were immovable, doth ever keep the same distance from the Heavenly Orbs.

This happens to the Earth, not because it is the Center of the Universe, as it is commonly supposed, and that all the Celestial Orbs, are rolled about its Circumference: For should we grant this to be, yet would the difficulty still remain, why the Earth does not reel from its place, why it doth not either mount upwards, or fall down. For if it be Heavy by Nature, how comes it to pass that it doth not rush downwards? If it be Light, why does it not fly upwards? Conclude we therefore, that the Earth doth hang pois'd in the midst of the Air, by means of the subtil matter, which continually whirls round it, and pierceth all the pores of it. For seeing that the Heavenly matter, which on all sides surrounds the Earth, is whirl'd about it with one and the same degree of Swiftness, which far exceeds that wherewith the Earth is moved, it cannot but hinder it from falling, or mounting higher. For as Birds are upheld by the Air from falling; so the Earth and the Moon, which circulate in the same Vortex, are supported by the same Matter that carries them along, and hindred from Reeling any way from their Centers.

V.
Why the
Earth, by
its weight,
doth not
come nearer
to the Sun.

The Earth, notwithstanding its weight, yet is not driven to the Circumference of the Sun's Vortex; but being kept within its bounds by the Heavenly Globuli that surround it, continues at a certain distance, viz. in the midst, between Mars and Mercury, without passing any further.

The Reason is, because the Planets, amongst which the Earth is, by reason of their different degrees of solidity, are more or less removed from the Center of their Vortex: So that Saturn, who is at the greatest distance from the Sun, is more solid than all the rest. And the Earth, tho' it seem to be a close and compact Body, yet is not of that solidity, as to sway it more towards the Circumference of its Vortex; forasmuch as Mars, who is much less than the Earth, yet is also more solid, by reason of the closer entanglement of its parts. For tho' the Earth, as to its surface, be very compact and solid, yet with respect to its bulk, it may well be accounted light; because the surface of it is not above 2 or 3 Mile in thickness, which is very inconsiderable, if compared to those vast Cavities it hides within its Bowels. And therefore as little Ships, such as have no great force, are easily kept in the River, and carried by its motion: So likewise the Earth, being fallen into the Vortex of the Sun, always keeps the same place, in which, by reason of its solidity it is ranged, and cannot be pusht any further towards the Circumference of the Sun's Vortex.

VI.
The Mag-
netical
virtue of
the Earth,
doth but
weakly
affect Iron.

The Earth communicates a Magnetick force to Iron; but the same is so weak, that it easily loseth it, and admits the contrary. Thus when we turn the End of a Bar of Iron, as yet not endued with any Magnetick virtue towards the Earth, immediately in that End which is inclin'd towards the Ground, it will obtain the force of the Southern Pole in these Northern parts, which in a moment it will lose again, and obtain the contrary; if that End which was towards the Earth

be turned upwards, and the other End inclined downwards.

The Reason whereof is the weakness of the Magnetick force that is in the Earth: For seeing that the striate Particles, which proceed from out of the Earth, do return thither again through the inner Crust of its upper Region, whence the Metals are dug up, it so happens that very few, or none of them return through our Air; those only excepted, who do not find a Passage in the said inner Crust open for them. Hence it is that Load-stones, that have fit pores for the reception of the said particles, have also a greater force to attract Iron; because the striate Particles meet with pores in the Load-stone, which are ranged in like manner, as are those of the inner Crust of the Earth: Whereas, when they pass through the Air, or through other Bodies of the outward Crust of the Earth, where they find no such pores, they move with more difficulty, and consequently also fewer of them come to us.

Persons that Travel from North to South, find that the Northern parts of Heaven sink lower and lower, and by degrees withdraw from their sight; but they who pass from South to North, do find the Northern parts of Heaven to be raised higher; so that after having Travelled 73 Italian miles in length, or 24 common French Leagues, the Northern Pole will be raised a Degree higher.

This Experiment proves the Earth to be Round; for if the Earth were plain, no such Change could be perceived. For tho' we should suppose a Man to be plac'd directly under the Pole, yet would there be no change in the elevation or height of the Pole; for if he should withdraw from it in a Right Line, the depression will not be equal, nor after he hath Travelled onwards 73 Miles, would he find one Degree left behind, but the withdrawing will become still less and less, because of the continual decreasing of the Angle: So as that at last 73 Miles, would scarcely make a depression of 1 minute of a Degree: Which is contrary to daily Experience.

The Roundness of the Earth is not hindred by those high Mountains that are found on the surface of it, many of which rise much higher than the Clouds, as Olympus, Athus, and the Peak of Teneriff. Because the Roundness that is attributed to the Earth is not Mathematical, as if the Lines drawn from the Center to its Circumference were all perfectly Equal; but only Physical, that is; such a Roundness, as is suitable and convenient for the Universe; forasmuch as these Inequalities are of so great moment, that they do not come into any consideration, when compar'd with the vast amplitude of the Body. For seeing that the Semidiameter of the Earth, is of 860 miles, the proportion of the greatest height of the Mountains, to the Semidiameter of the Earth, will be as one 1 to 860. And forasmuch as there be but very few Mountains that are perpendicularly so high, and that the most of them are scarcely one Quarter of a Mile in Height, it is evident that they can no more spoil the Roundness of the Earth, than some small Unevennesses in the Round Balls made by Artificers, do hinder their being Round. For indeed, there is not a Body to be found in the whole Universe that is perfectly and absolutely Round, that is, which hath an exact Geometrical Roundness.

This

VII.
They who
Travel
from North
to South,
find the
Northern
parts to be
withdrawn
from their
sights.

VIII.
The Mountains
do
not hinder
the Round-
ness of the
Earth.

IX.
The Variation of the Altitude of the Pole, proves the Roundness of the Earth.

This *Physical Roundness* of the *Earth* may be demonstrated by the following Experiment: When a Man travels *North* or *South*, he will find the *Altitude* or *Elevation* of the *Pole* to vary continually, whether he go a *Plain-way*, or *Up-hill* and *Down-hill*: So that if being at the *Foot* of a *Mountain*, and having observed the *Elevation* of the *Pole*, he *Travel* the whole day towards the *South*, he will not perceive the *Elevation* of the *Pole* to be increased, but rather decreased, by that time he comes to the top of the said *Mountain*. Neither will he in like manner find the same *Altitude* decreased, but diminished, if having taken the *Elevation* of the *Pole* at the top of the *Mountain*, he goes down again to the bottom of it. Which is an evident Proof, that the *Devexity* or bending downwards of the *Earth*, is every where perceptible, and that a perpendicular falling upon any different Points, whether of *Acclivity* or *Declivity*, do all tend downwards by different Lines, that will meet at last in the *Center*.

CHAP. II.

Of Water.

I.
Water is more hard to be congealed, than Oil.

WE daily Experience, that *Water* is more difficultly congealed than *Oil*, and that it never is frozen without there be a vehement Cold in the *Air*: Whereas *Oil* is apt to congeal in any place, where the *Air* is only inclining to Cold. And, on the other hand, *Water* is sooner turned to *Vapours* than *Oil*, if they be both exposed to the *Sun*, or set over a *Fire* of the same heat.

The Reason why *Water* is fluid, and doth not so easily congeal as *Oil*, is, because it hath smooth and slippery parts, like *Eels*; which tho' they lye close, and be entangled together; yet they never stick so close, but that they may be easily separated again. Whereas *Oil* consists of Parts which are easily entangled, and stick fast and close together: Which is the Reason why *Oil* is not so easily resolved into *Vapours*, as *Water*, the parts whereof, by the agitation of the subtil matter, are easily separable and hang but loose together.

II.
Why Water will not easily mix with Oil.

From hence it appears also, why *Oil*, or *Air*, cannot, without great difficulty, be mingled with *Water*; because their parts do more easily joyn together, than with the parts of this: For if you beat *Water* and *Oil* so long together in a *Vessel*, till they appear as one and the same *Liquor*; yet cannot they continue so long, but that the parts of *Oil* meeting again with one another, will cling together, and form several Drops, which being carried to the top of the *Water* by their Lightness, will there continue, whilst the parts of the *Water*, at the same time, do likewise run together into Drops, and so by their weight fall down to the bottom of the *Vessel*.

III.
That Water is not cold, as Aristotle would have it.

From what hath been said, may likewise be gathered, that *Water* is not cold of its own Nature, according to *ARISTOTLE's* Opinion, seeing that it admits heat, and doth not let it go, but by imparting it to the *Air*, which is colder than it. We find also, that when a *River* freezeth, the *Ice* begins at the Top, that is, in that part which is touch'd by the cold *Air*: Which would not happen so, if the *Water* were cold of its own Nature; for then it would begin to freeze either in the midst,

or at the bottom; or at least would freeze as soon in the midst, as at the top; which yet is contrary to Experience.

And for the same Reason it is, that *Wine* is not so easily congealed as *Water*; because in the *Wine* there be many subtil particles, easily moveable, and which are swiftly and readily agitated by the *Celestial matter*, which because of their subtilty are called *Spirits*. And therefore it is, that by how much stronger the *Wine* is, so much the harder it is to be frozen; and that the *Spirit of Wine*, when freed from its *Phlegm*, doth elude all the extreamest force of Cold. And accordingly it hath been found by Experience, that if a *Vessel* of some Rich *Wine* be exposed to the *Air*, in extream Cold weather the watry part of the *Wine* will be frozen, and the *Spirits* will continue liquid and fluid in the Center of it.

The weight of *Water* is not felt at the bottom of a *River*: Which is a thing experienced by *Divers*, who are not prest down by the water that lies upon their Heads; but are as much at liberty for all that, as if they were in the free and open *Air*.

The Reason whereof is, because no more of the water doth exert is gravity upon the Body, than would descend, in case the Body did remove out of its place. For suppose we a Man placed at the bottom of the *Vessel* B, and lying in such a manner with his Body on the Hole A, as to hinder the water from running out of the *Vessel*, he will find that the whole weight of the *Cylinder* of water A B C doth lye upon him, the Basis whereof I suppose to be of the same bigness with the Hole A; who, if he himself should pass down through the Hole, the whole *Cylinder* of water would descend likewise; but if we should suppose the man placed somewhat higher at B, so as not to hinder the Egress of the water at A, then would he no longer perceive any weight of the water which lies upon him between B and C; because if he should sink down towards A, yet the water would not fall down with him; but on the contrary, that part of the water which lies under him towards A, to the same bulk as his Body is, would come up into his place: Whence it appears, that the water rather carries him upwards, than bears him down, as may be proved by the Example and Experience of *Divers*. For which Reason also it is, that they cannot reach the bottom of the *Sea*, without some weight hung at their Feet.

For the same Reason it is, that Bodies which being weighed in the *Air*, are found to be of Equal weight, do lose the same equality when they are weighed in the water. Thus when *Lead* and *Copper* being weighed in the *Air*, are found of equal weight, if they be weighed under water, they lose the same: Because the *Lead* takes up less place in the water, than *Copper* of the same weight does; and therefore in water it must needs preponderate, tho' in the *Air* it was of equal poise with the *Copper*.

Water, if it stands still without motion for a while, or if it be kept close in a *Vessel*, doth putrefie and stink.

The Reason is, because tho' some small quantity of *Salt* and *Sulphur* be found in water; yet, because upon its standing still, they become loosed from

IV.
Why Wine is frozen sooner than Water.

V.
A Man under Water, doth not feel the weight of it.

Figure 18.

VI.
Things weighed, that are found to be of equal poise in the Air, do lose the same when weighed in the Water.

VII.
How water comes to putrefie or corrupt.

from the union they had with the parts of the *water*, and run together, they consequently do easily evaporate, and thereby cause Putrefaction. Whereas, as long as the *Water* continues in *motion*, the *particles* of the *Salt* and *Sulphur*, are mixed with those of the *water*, and by this means become entangled, and are hindered from flying away, and leaving the *water* destitute of that which doth preserve it from Putrefaction.

VIII.
Why the
Water
sinks, or
rises
higher in
a Vessel.

Water contain'd in a *Glass-Vessel* or *Tube*, without filling it to the top, appears lower in the *midst*, than at the *Sides* or *Edges*. Whereas, on the contrary, if the said *Vessel* be fill'd to the very top, it will appear swell'd and higher at the top, and inclining to a *Spherical figure*.

The Reason is, because the *Air* presseth down the middle part of the *water* on every side, in a *Vessel* that is not quite full; whereas it only presseth the outsides of it more obliquely. But when the *Vessel* is full of *water*, besides that the *water* is more firmly clos'd in the *Vessel*, its middle parts are only drawn together by the *Air* that lies above them; whereas the *Extream* parts are compress'd, as well by the *Air* that is above them, as by that which is on the *Edge* or *Brim* of it.

IX.
What is
the Cause
of the
Roundness
we find in
the Drops
of *Water*.

The *Drops* or *Bubbles* that are seen in *water*, are *Round*; but as soon as they touch others, they unite, and are confounded with them.

The Reason of their *Roundness*, is the equal pressure of the ambient or enclosed *Air*. For a *Drop* of *water*, being, as it were, pois'd on its point of *Contact*, is equally prest on all sides by the *Circum-ambient Air*. And as soon as it toucheth another *Drop*, because the pressure in the place of *Contact* is thereby weakned, it presently becomes joyned with it. And therefore it is, that those hanging *Drops*, which are, as it were, supported every where, and surrounded by the *Air* that doth encompass them, are driven that way, where there is no *Compression*; that is, towards that part where they rest upon solid *Bodies*. And if you touch a hanging *Drop*, at the lower part of it, it immediately follows; because the *Air* doth not prest at the point where it touches a solid *Body*.

X.
Whether
the same
Roundness
is not
observed
in the
Drops of
Spirit of
Wine.

But the *Drops* of *Spirit of Wine* are never *Round*; for seeing that this *Spirit* is very light, it consequently abounds with so many *Pores*, and its surface is so much interrupted, that but few parts of the *Air* can apply themselves to it; in order to their compressing of it into a *Round figure*, seeing that the most of them run through it, endeavouring the destruction of it. And therefore if this *Liquor* be poured down from on high, it doth not fall down in *Drops* like *water*, especially if it be highly rectified, but is immediately dissipated in the *Air*, that no sensible part of it comes to the *Ground*: Or, if it be pour'd on a *Table*, cover'd with *Dust*, it doth not turn into round *Drops*, but spreads it self every way, and mingles it self with all the *Bodies* it meets with.

XI.
Whether
Water
may be
made of
Air.

Air is sometimes condensed into *water*: Which we see in the production of *Fountains*, the Cause whereof the *Ancients* very probably assign'd to be, the changing of the *Air* into *Water*; which change is facilitated by the rest or stagnation of the *Air* in those parts, and by the coldness of the *Rocks*. For it is found by Experience, that *Foun-*

tains are most commonly generated in such places as these.

The Maintainers of this Opinion do very well to add the word, *Probably*, seeing there be several that utterly deny this, and prove the contrary by Experiment. A Modern Person, and great searcher into the *Nature of things*, took a *Glass-Vessel* with a long Neck, containing a *Quart*, and sealed it *Hermetically*; which *Vessel*, wherein was contained nothing but *Air*, he plac'd in a *Barrel* full of *water*, and left it there the space of 3 years, and never removed it thence all that time, save only to observe, whether any change had hapned to the *Air*; but he never could perceive the least alteration, or that any part of the *Air* was changed into *Water*; which according to the former Supposition ought to have hapned, because of the moist and cold *water*, wherewith the *Air* was surrounded on every side. Which proves them to have been mistaken, who supposed that that which was sufficient to turn *Water* into *Ice*, would also turn *Air* into *Water*: Since this change could not be brought about, by means of *cold* and *moisture*, in the time of 3 years. And the Reason of it is plainly this, because the *particles* of the *Air* being very *subtil*, are so continually agitated by the motion of the *subtil matter*, that they always are tost through one another, and therefore can never be turned into *Water*, no not by means of the most intense *Cold*.

A *Rope*, or *Cord*, if it be sprinkled with *water*, so that it sink through it, becomes contracted, and is not so long as it was before.

The Reason is, because the several *Threads*, whereof the *Rope* is composed, are as it were so many *Pipes*, which are blown up by the letting in of *water* into them, and so become shorter. Hence it is that the *Strings* of a *Lute* break in moist and wet weather, if they be wound up too high: For that the *Threads* of them, turning round like a *Screw* about other greater *Cylinders*, do by this means become contracted, and lose something of their length.

All *Water*, but more especially *Rain-water*, is insipid, and hath either no taste at all, or such as is hardly perceptible.

Tho', to speak exactly, there be no *Bodies* in this *Universe* that are altogether insipid; yet are some so called, because they are not endued with any eminent or very perceptible *Taste*; such as are some cold and waterish *Herbs*, the *Raw white* of an *Egg*, and *Common water*; because their *particles* have smooth surfaces, which do not enter the pores of the *Tongue*, nor can vellicate or twitch, but only glide over it. Thus *Air* is look'd upon to be insipid, because it swims upon our *Spittle*, and not mingling with it, makes no impression at all upon the *Nerves*. And for the same Reason it is, that fat *Liquors* do relish less than others.

Filtration cannot be performed, but with a piece of *Cloth*, that is thoroughly made wet with *water*: Or, if you will, *Water* will not ascend by a *Label* of *Linneen* or *Woollen cloth*, nor run down by that part which reaches down on the outside of the *Vessel*, except this part be first thoroughly made wet: For if the propendent part continues dry, the *filtration* can never proceed.

XII.
Why a
Rope being
sprinkled
with wa-
ter becomes
shorter.

XIII.
In what
sorte *Water*
is said to
be insipid.

XIV.
In Order
to the
filtering of
any *Liquor*
by a *Strip*
of *Cloth*,
the *Cloth*
must first
be moist-
ned.

The

The Reason is, because in *filtration*, the outward parts of the *water*, wherewith the cloath is wetted, do so insinuate themselves into the *Threads* of it, that they produce there a kind of *thin skin*, through which the inner parts of the *water*, which are in continual agitation, run downwards, and are carried towards that part of the *Cloth* which hangs down without the *Vessel*. Whereas, when any part of the *Cloth* continues dry, and unextended by any *Liquor*, so long this *Pipe* cannot be compleated, which is necessary for the conveying of the *water*; and therefore it is necessary that the whole *Cloth* be moistned. For we must not imagine, that the part of *Cloth* which hangs down without, becomes moistned, because the *water* that is contained in the *Vessel* is driven upwards, for this would be contrary to Nature; but the reason of it is this, because that part of the *filter* being dipt in the *water*, its *Pores* are thereby widened, and so prepared to admit more *water*, which by degrees entering more copiously into the same, doth still more widen the parts, and so continually makes way for the following *Liquor* to ascend.

XV. After the same manner as *Liquors* mount up by *filters*, so likewise doth *water* ascend in a *Pipe* full of *Sand*, placed perpendicularly in a *Vessel* full of *water*, and whose bottom or lower end, is stop't with such a *Body* through which the *water* can penetrate. For if we leave this *Pipe* thus, the time of 24 hours, we shall find the *water* to be mounted up in the *Pipe* through the *Sand*, about 18 inches high above the *Level* of the *water*, that is in the *Vessel*.

XVI. Those that *Swim* take notice, that the *water* of *Rivers* doth not every where flow alike, and that the stream of the *River* runs more slowly at the bottom, than at the top.

It is not so in all *Rivers*, but only in such whose bottom or channel is uneven, and hath deep holes in it; for where all the parts of a *Channel* are level, there is no reason why the course of the *River* should be more slow at the bottom than at the top. Conclude we therefore, that this happens in such *Rivers* only when the bottom is interrupted with deep holes, where the *water* is detained longer, than it would be on a *level*, and consequently doth not move so swiftly as the *Surface*.

XVII. Hence it is evident that *water* always takes its course that way, where it finds a *down-hill*; for seeing that the upper parts of the *water*, do by their *weight* press those that are under them; and that they by reason of their fluidity, except they be kept in on the sides, do spread and slip away; it must needs be that when the *water* is upon a hanging ground, and its lower parts press by the upper, it must give way and run downwards, to avoid that pressure. For a *down-hill ground*, is more open than a plain or level, for seeing it is nothing else, but a range of perpendiculars the one shorter than the other it, cannot be otherwise, but that the *water* that lies upon a *shelving ground*, upon its being press't must slide down, towards the shorter perpendicular. So that it is manifest that no *water* flows upon the *Earth*, but what moves *down-hill*, by reason of the shorter perpendicular.

Let a *Glass Vessel* be made, with a narrow *Arm*, and fill'd with *water*: The *water* which is in the *Vessel*, will not be able to thrust the small quantity of *water*, which is in the *Arm* out of its place, nor lift it up higher, tho' it be in much greater quantity, and exceed it in weight.

This effect is to be attributed to the *Heavenly matter*, which is most swiftly carried round the *Earth*, and drives all *Earthly Bodies* towards the *Center* of their motion. For seeing that the *water*, which is in the *Vessel*, and that in the *Arm* of it have an equal *Surface*, they are consequently alike pressed downwards by the *Heavenly matter*; and therefore that great quantity of *water* which is in that large *Vessel*, hath no power to push the little *water* that is in the *Arm* out of its place, or to raise it higher.

The *Surface* of the *water* is more difficultly divided, than the more inward parts of it: For little *Steel needles*, being laid crossways on the *Surface* of the *water* swim upon it, but as soon as they have divided the top of it, do without stop sink to the bottom.

The Reason is, because tho' the parts of the *water* be uniformly moved, and constitute a smooth and even *Surface*; yet the parts of the *Air*, that surround the *water*, are agitated after a different manner, without any such uniformity in their Motion; by which means it comes to pass, that the *Surfaces* of *Air* and *Water* become smooth and polished; as we see that rough *Bodies* are polished by rubbing against each other. Now it is apparent that smooth *Bodies* are more apt to resist, and exert a greater force in putting by other *Bodies*. And therefore it cannot seem strange, seeing that the *Surface* of *water* is more difficultly divided, than its under parts, that it should support *Steel needles* laid upon it. Yet to this end, the *Needle* must be very slender, and must be laid a thwart upon the *water*, for otherwise the effect would not follow.

From what hath been said may be gathered, why a *Ship* with a sharp *Keel*, doth draw more *water*, and better cuts the *waves*, than that which hath a broader. For a *Ship* pusheth and takes up so much *water*, as its weight is, and all it contains, that so the *water* may be prest equally on all sides. Now the sharper the *Keel* is, with so much the lesser compass it doth beat back and push against the *water*, and doth more easily divide it, than when it is broader; for then it draws but little *water*, and pusheth away a greater quantity of it. And therefore it is, that the Foundations of the *Arches* of a *Bridge* are made sharp pointed towards the *water*, that it may slantingly slide by without exerting its force upon them.

CHAP. III.

Of the wonderful Properties of some sorts of Waters.

SOME *Waters* are *hot* when they break out of the *Ground*; yea there are some *Springs* that are so *hot*, as to boil an *Egg* hard that is put into them.

Some derive this *heat* that is found in *hot Baths* from *Subterraneous Fires*, which lye hid

XVIII. Water contained in a Vessel of unequal thickness is not driven forwards by a greater bulk of water.

XIX. Why a Needle swims on the top of the water.

XX. The sharper the Keel of any Ship is the more water is drawn.

I. Of the cause of hot Waters or Baths.

in the *Bowels* of the *Earth*, and are diffused up and down through it by certain *Channels*, which as the *water* passeth through, it becomes heated. But this doth not seem agreeable to Reason; for whence are these *Subterraneous Fires* fed and maintained, where is their *Fuel*, or how can the same be kindled into a flame under ground? Or how comes it to pass that these *Fires* are not choaked by the smoak that proceeds from them? Or why do not they dilate themselves, and breaking out at the *Surface* devour all before them? It seems therefore more probable, that this *heat* of some *waters* is the effect of a mixture of *Liquors*, proper to produce that quality; as we find that *water* poured upon *quick Lime* grows hot; and the same effect ariseth from the mixture of *Oyl of Tartar*, with *Oyl of Vitriol*; and *Butter of Antimony*, with *Spirit of Niter*: Which tho' singly they be *cold Liquors*, yet when put together, produce a very intense *heat*; for if *Oyl of Tartar* be poured into *Aqua fortis* wherein *Iron* is dissolved, it will not only *work* and *boil*, but break forth into a *Flame*.

Conclude we therefore, that the *heat* of *Baths* proceeds from a mixture of *Jews Lime* and *Brimstone*, which being united together produce *heat* by effervescence.

II.
The heat
of Baths,
doth not
proceed
from subter-
raneous
Fires.

That this is so, may be evidently proved from hence, that the *water* of *hot Baths* being set upon the *Fire*, is as long a *boiling* as any other *cold water*: Neither doth it scorch and burn the *Tongue* as common *water* doth, which hath acquired a like degree of *heat* from our *Culinary Fire*; which shews that the Subject of this *heat* is a thin *Vapour*, which doth not so much penetrate the parts of the *Tongue* and *Mouth*. It is found likewise that this *water*, doth not *boil* and make tender, soft and juicy *Herbs* that are put into it, such as *Sorrel*, &c. as soon as common *water*, that hath the same degree of *heat*. The reason whereof seems to be, because the *Volatile Sulphurs*, that produce the *heat* in these *waters*, do so insinuate themselves into the *Pores* of the *Mouth*, or of the *Leaves* of *Sorrel*, that they hinder the *water* from entering into them; or because the *heat* of these *waters* doth wholly consist in these *Sulphurs*, the parts whereof are so *Subtile*, that they cannot exert their force, neither upon the *Mouth*, nor upon the *Leaves* of *Sorrel*; for the very same reason that the flame of *Spirit of Wine*, will not burn a *Handkerchief* that hath been dipt in it.

III.
Corrosive
Spirits do
dissolve
Metals, and
rather act
upon hard
than soft
Bodies.

Corrosive Spirits, or *Stygian waters*, as the *Chymists* call them, do penetrate the hardest of *Metals*, and in a short time do dissolve them; but act little or nothing at all upon *Wax* which is soft, but leave it in a manner untouched. The said *waters* do also more easily dissolve *Iron* and *Steel*, than *Lead*, which is softer than they, and more easily divisible.

The reason is, because these *Corrosive Spirits* do not meddle with those *Bodies* that give way to them, but crumble them to pieces that oppose and resist their entrance. Which will be easily apprehended by those who know that all *Bodies*, do not consist of the same parts, nor have their parts joyned in one and the same manner, but suitable to the variety of their *Bulk* and *Figures*. For as a heap of *Earthen Vessels*, may with a

Stick be broken into a Thousand pieces, whereas *Wool* being struck with the same Stick and force, doth admit no change at all; and as *Wool* may be easily cut with the edge of *Knives* and *Scissars*, whereas *Earthen Vessels* cannot; so we may easily understand, how some *Bodies* are easily dissolved by *Corrosive Spirits*, whereas others are scarcely toucht by them.

Historians tell us of a *River* in *Epirus*, producing contrary effects. In *DODONA*, saith *PLINY*, Is a *Fountain* dedicated to *Jupiter*, which tho' it be cold and doth extinguish the lighted *Torches* that are put into it, yet doth it kindle those which are extinguishd when approacht to it.

This seems at first sight impossible, that inflammation should proceed from a cold Body as the *water* is: Yet for the clearing of this difficulty we may say, that the *water* of this *Fountain* being cold, does extinguish a flaming *Torch* that is dipt into it, this being the property of *water* to quench and choak *Fire*, and so put a stop to the motion of its agitated parts; but the rekindling of extinguishd *Torches*, cannot be attributed to the *water*, but to the *Bituminous* and *Sulphurous* exhalations, that rise up from the *water*. For it is probable, that this *Fountain* did send forth *Vapours* mixt of *Jews-Lime*, *Brimstone* and *Nitre*, which rising up through the *Fountain* as through a *Chimney*, became inflammable in the open *Air*, especially when a newly extinguishd *Torch* was approacht to them.

GASSENDUS upon occasion of a *Fountain* mentioned by *PLINY*, which *Flows* and *Ebbs* thrice a day, mentions the *Collismartian Fountain*, which *Ebbs* and *Flows* 8 times in an hour; for the *water* being ready to break forth, discovers it self by a soft *purling noise*, and for about half a minutes time *swells* and encreaseth, and the 6 following minutes decreaseth again; and when the decrease is ceased, the *water* continues in the same state for a little while, and then begins to flow again. But the intervals between one *Eruption* and another, are not equal, being sometimes more, and at other times less; tho' it very seldom happens, but that in one hour 8 *flowings* or *Eruptions*, and as many *Cessations* or *Ebbings* may be perceived in an hour.

It is certainly a difficult matter to render a satisfactory reason of this interrupted flowing of the *water*; neither will the instance of the *Fountain* in *Epirus*, be of any great help to us towards the solving of it. For whereas the same abounds with *water* in the *day time*, which fails and ceaseth in the *night*, this may be attributed to the *heat* of the *Sun*, whereby *Fountains* in *Summer-time* are often dried up, and overflow in the *Winter*. But this cant be applied to the *Collismartian Fountain*, which observes its interrupted *Ebbings* and *Flowings* in the *night*, as well as in the *day time*. However, if I may speak my conjecture concerning so abstruse a *Riddle* in *Nature*, I am apt to believe, that within the *Hill* whence this *Spring* breaks forth, there is some *hollow*, or *pit*, which a *Rivulet* continually fills up: As likewise a passage through which some *subterranean steam*, or breeze continually blows, and keeps back the *water*, sending it back to the place opposite to that from whence it came; where it then *swells* and

IV.
A Fountain
of Epirus
extinguish-
eth flaming
Torches,
and kindles
those which
are extin-
guishd.

V.
The cause
of the in-
terruption
of the flow-
ing of the
Collismar-
tian Foun-
tain.

and encreaseth, till being overcome by its own weight, it overbears the force of the *Wind*, and so runs down, until the *hollow* or *pit* be almost exhausted and remain dry. And after this the *Wind* having recovered its free passage again, doth as before withhold the *waters* that would run out, and continually drives it back, until by force of the *water* that breaks in, it be driven away again, and give way to it.

VI.
Another
like River.

A like *Fountain* to this is mentioned by F. Maignam Tolosas in his *Horary Perspective*, which in *Summer* time doth every *hour* flow from a vast, and most deep *hollow*, and for a quarter of an *hour* encreaseth by degrees, with a very great noise; and the next quarter becomes a great *River*; the following quarter it sinks again, and the last quarter, lies still, and is in a manner quite dry'd up.

VII.
What is
the cause
of poisonous
or deadly
Fountains.

Some *Fountains* are *Poisonous* and deadly, as was that famous one of *Terracina*, which was called *Neptunes*, in the Country of the *Volsci*, which was the death of all those that drunk of it, and therefore was stop't up with *Stones*, by the *Inhabitants*.

This may be occasioned when the *waters* of such *Springs* run through *Arsenical*, *Mercurial* or *Antimonial Mines*. For as the *Fumes* of *Arsenick* do kill living *Creatures*, so *waters* impregnated with the said *Steam*, produce the same effect. Of this kind is the *Lake Asphaltites*, because of the *Arsenical Jews-Lime* it abounds with; and many other *Fountains* that are found in the Countries about the *Alps*; but as soon as they are discovered they are filled up and stop't with *Stones*, which is the reason why so few of these deadly *Springs* are known.

VIII.
Whether it
be true that
the Fountain
of Jupiter
Ammon
was cold
and hot by
turns.

In the Province of *Cyrene*, as *Historians* tell us, was a *Fountain of the Sun*, which was hot at *Midnight*, and afterwards growing luke warm by degrees, was cold at the breaking of day; and as the *Sun* rose higher, grew still more cold, so that at *Noon* it was cold to extremity; and from that time began by little and little to grow luke warm again, till at the beginning of *night* it was hot, and so grew hotter and hotter till *Midnight*.

Some *Philosophers* have endeavour'd to give a reason of this change, by asserting that there are some *Seeds of heat* in *water*, which the *Earth*, when chill'd and contracted with the coldness of the *night* sends forth, but when dilated by the *heat* of the *day*, doth take in again. But I fear that in this case, we are vainly employed in searching for a true cause of a meer figment; seeing that *ARRIAN*, *CURTIUS*, *PLINIUS*, *MELA* and other *Historians* and *Geographers*, who give the description of this *Fountain*, did never see it, and had only by report whatsoever they relate concerning it. Every body knows how basely the *Priests* of *Jupiter Ammon* did flatter *Alexander*, when he visited that *Temple*, and therefore we cannot think strange if they made him believe many things, which they feigned, or by some imposture represented to him, to make him conceive a greater veneration for the place and them. And therefore I think it is but reasonable that we should be fully assured of the truth of the thing, before we trouble our selves about searching out the cause of it.

Well water in *Summer* is cold, and in the *Winter* hot, or at least somewhat luke warm.

This cold and heat doth not proceed so much from the *water*, as from our *Sense*, which finds the *water* colder in *Summer* than *Winter*. For when we touch any thing with a very cold *Hand*, it appears warm to us; as those things feel cold, which we touch with a hot *Hand*. This we experience when we enter into hot *Baths*, which are distinguished by several Degrees of heat; for when we are enter'd into the first *Bath*, we think it warm, because our *Body* is yet cold, but when we return again from the hottest *Baths* to the first where we entred, we take that to be cold then, and not hot as we thought it was at our first entrance into it. And the same is the case of *Grottos* and *Caverns*, which always are of the same temperature, but are thought to be cold, because in the *Summer* we come into them out of the hot *Air*, in comparison of which they seem cold to us: And in the *Winter* seem hot, because the *External Air* is much colder, than those *Grottos* or *Caves* are, with respect to which we think them warm. As before hath been shewed by the Example of *Oil*.

We must not conceit, as some *Peripateticks* do, that the *steam* which in the *Winter* time appears upon *Well water*, doth impart any heat to them, because that *steam* when felt by the *Hand*, will be found as cold, as the *Air* that surrounds it: Whereas the *water* it self will be found to be hot; which is a sufficient proof, that the *water* borrows no heat from the *steam* that lies upon it. Moreover we find as much *steam* lying upon the surface of hot *Baths*, as upon *Well-water*, and yet no body will say, that this heat which is in those hot *Baths*, proceeds from the said *steam* or *vapor*, seeing that it scarcely covers the *water*, and disappears in a Moment. The reason therefore why *Well-water* in *Winter* time seems to be hot to us, is, because we come to it from the *External Air*, which is many Degrees colder.

The *water* of some *Springs* does inebriate like *Wine* or other strong *Drink*, and this effect is attributed to the *River Lethe*, which being drunk of too freely, does produce the same effect as *Wine* does. Others again being drunk cause *Madness*, or *Dull* stupidity.

The cause whereof must be ascribed, to the *Jews-lime* wherewith those *waters* do abound. For *Jews-lime*, doth strongly affect the *Brain*, and by obstructing the *Pores* of the *Nerves*, doth dull and stupify the *Senses*; much in the same manner as the seeds of wild *Parsneps*, (as *AGRICOLA* tells us in his 2d Book of things flowing out of the *Earth*) being wrapt in a thin *Linnen*, and put in *Wine* do; as also the powder of the *Flowers of Hermodactils*, which being put into *Wine*, do presently, and strongly inebriate. And thus *Jews-lime* being mixt with *water*, doth inebriate those that *Drink* of it, and makes the *Body* heavy and lumpish.

We are told of a *Fountain* in *Arcadia*, near the City *Clitor*, and from thence called *Clitorius*, which makes those that *Drink* of it to have an aversion for *Wine*, as *Ovid* assures us.

Who with *Clitorian Streams* his Thirst allays,
Doth *Wine* abhor, and *water* Drinks always.

The

IX.
What is
the reason
of the heat
that is
found in
Well water
in the Win-
ter season.

X.
The steam
that lies up-
on the wa-
ter doth
not commu-
nicate any
heat to it.

XI.
Of Springs
that make
the persons
that Drink
of them,
Drunk, and
others that
make the
Drinkers to
run Mad.

XII.
A Fountain
that makes
the Drink-
ers of it
to hate
Wine.

The Reason is, because, as *Wine* doth cause a nauseousness, not only to those that are drunk, but also after that they are grown sober; so those who drink of those *Fountains*, impregnated with *Jews-Lime*, and having had their Heads clouded and troubled thereby, become affected after the same manner as those who are sick of an *Ague*, and abhor *Wine* and the smell of it.

XIII.
Some Diseases are cured by Medicinal Waters.

Some *Waters* are endued with a *Medicinal Virtue*, and are made use of by *Physicians* for the curing of several *Diseases*.

The *waters* derive this their virtue, from some *Metalline* or *Mineral Matter* which they pass through, as *Brimstone*, *Salt*, *Vitriol*, *Alome*, *Nitre* and *Jews-Lime*. And hence proceeds that great variety which we find in *Waters*; for *Sulphurous Waters* do heat and attenuate; *Bituminous* do dull and cloud the *Brain*; *Aluminous* do dry moist and running *Sores*; and *Vitriolick* do adstringe. Some of them are immediately conveyed to the *Bladder* and *Urinary passages*, by opening and dilating the pores that make way for the said *water* to pass to those parts.

XIV.
Of pretended Miraculous Fountains.

As to those *Fountains*, of which many *Miraculous Effects* are reported, we may take it for granted, that their highly extolled *Virtues* are commonly grounded upon the reports of some poor People, who are many times set on by others, for Money, to tell many Lies concerning the *Miraculous Effects* they have performed. For whatever some may talk, there is no *Universal Remedy*, or such as is able to cope with, and overcome all *Diseases*. And seeing that great numbers of People do drink, or otherways make use of these *Miraculous Fountains*; those that suppose themselves to have been benefited by them, do extol them; when in the mean time we hear nothing of those to whom they have been of no use at all.

CHAP. IV.

Of Fountains and Rivers.

I.
How Fountains come to spring on the top of Mountains.

Nothing is more frequent, than to see *Springs* break forth from the *Bowels* of the *Earth*, and mounting upwards, contrary to the natural weight of *Waters*, to make their way through the tops of *Mountains*.

Different Reasons are given by several Men of this Eruption of *Fountains*. Some suppose that the *subterranean waters* do mount upwards through certain *Pipes* or *Channels*, much in the same manner as the *Blood* in the Body of an *Animal* is conveyed through the *Veins* to all the parts of it, to the *Head*, as well as to the *Feet*. This Opinion *PLINY* seems to favour in his 2d Book, Chap. 65. For seeing that the *Earth* is dry and thirsty, and cannot consist of it self without Moisture; nor the *Water* neither without the *Earth* supporting and containing of it; it seems necessary that we admit some *Veins*, through which the *Water* may be conveyed, and get up to the tops of the *Mountains*. But yet it does not seem probable that the *water* should be this way conveyed in the *Earth*, as *Blood* is in the Body of an *Animal*: For tho' the *water* be driven out of the *Sea* into the *subterranean cavities*, and by this force impress upon it, do continue to mount upwards; yet

no sufficient Reason can be given, why the *water*, by that time it is risen as high as the surface of the *Sea*, should not stand still there, or fall back again, seeing that the force wherewith it was pushed upwards, now ceaseth.

Whereupon it seems more likely, that the original of *Fountains* ought to be ascribed to *Vapours*, or particles of *Water*, separated from each other by the force of *subterraneous heat*. For seeing that under *Plains* and *Mountains* great *Cavities* lie hid, that are filled with *water*, it cannot be questioned but that a great part of them are continually resolved into *Vapours*, and sublim'd to the surface of the *Earth*, and the tops of the highest *Mountains*; which by succeeding Cold being afterwards turn'd into *water* again, cannot return back the same way by which they mounted, and therefore find out other open passages between the Intervals of the *Crusts* or *Shells* whereof the *Earth's* surface doth consist.

Some *Fountains* flow continually, and much with the same force, and abundance of *waters*; whereas others are subject to a great decrease in *Summer* and *Autumn*, and some do wholly dry up.

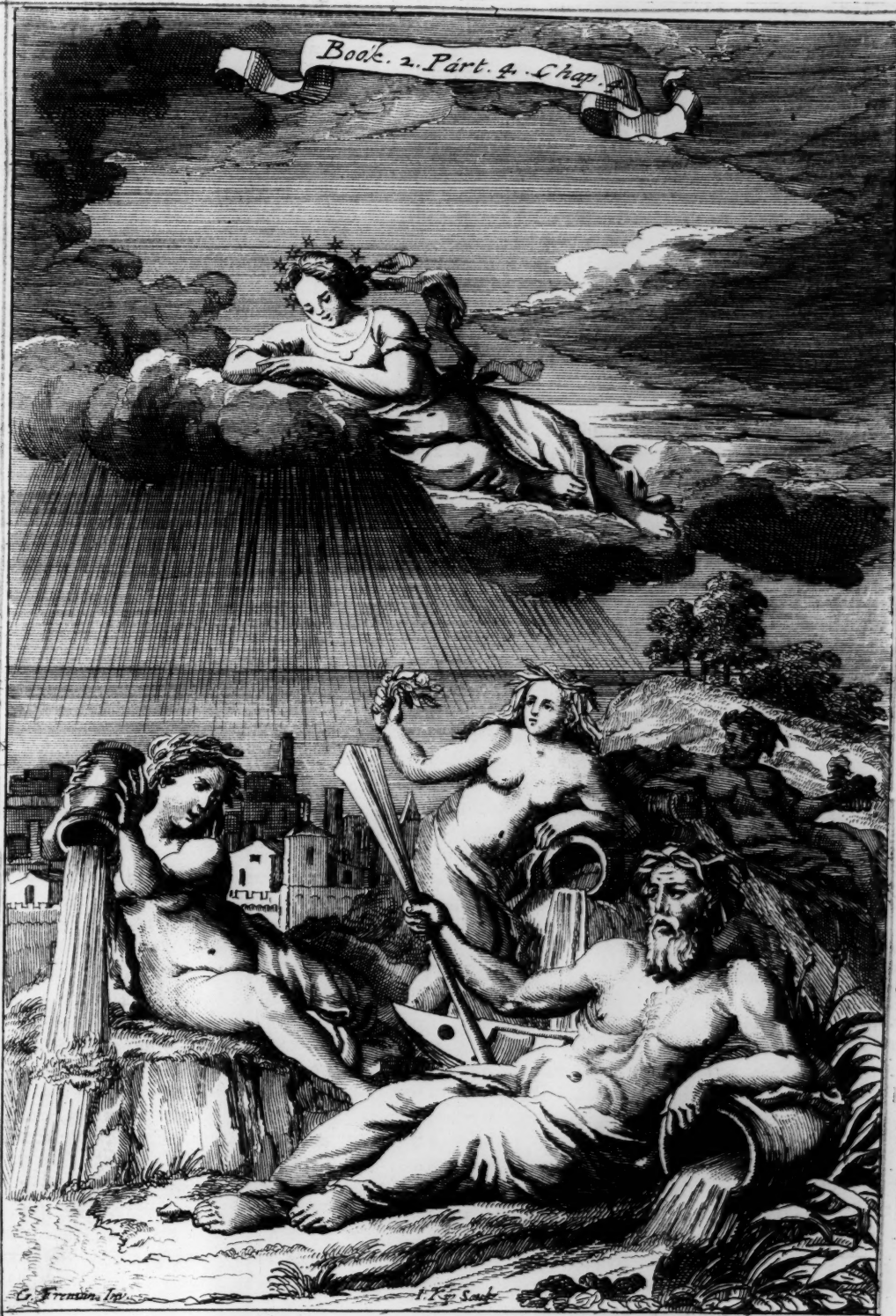
The reason of this decrease in some *Springs* is, because the pores of the *Earth* are very open during those *Seasons* of the *Year*, by reason of the *Heat* that dilates them; and by this means furnish the *Vapours* a ready and open way to fly away, and mingle with the *Air*, and therefore can no more supply the *Spring* with *water*, as they did whilst they continued shut up within the *Earth*. And it sometimes happens, that this *Evaporation* is so great, as to dry up the *Spring* altogether. But as to those *Springs*, that flow continually, and much with an equal force, the reason of their perpetuity is, because the *Channels* by which their *waters* are conveyed, are so deeply lodged in the *Earth*, the *Summers Heat* cannot reach them to dilate their Pores: which is the reason why the *Vapours*, being always furnish'd in the same quantity, must also produce an equal and continual springing, or flowing of the *water*.

Hence it is also, that in some hollow parts of the *Earth*, *Oyl* breaks forth instead of *water*, viz. when the *Heat*, that is in the *Bowels* of the *Earth*, is of force enough to lift up thick and gross *Exhalations*; which meeting with the cold parts of the *Mountain*, become thereby condensed, and joining together, constitute a thick *Liquor*, very like *Oyl*. Thus we are told of a *Valley* in *Alsatia*, called *Leberthal*, from whence there breaks forth a fat and thick *Liquor*, which *Waggoners* make use of to grease their *Wheels*. In *Scotland* also, 2 miles from *Edinburg*, there is a *Spring*, the surface whereof is covered with a *Black Oyl*, which the *Inhabitants* make use of to soften their *Skins*, and to heal the *Chops* and *Roughness* of it. So likewise amongst the *Antients*, the River *Liparis*, in *Cilicia*, was very famous, because those that bathed themselves in it, were as good as anointed with the *water* of it, which was so soft and *Oily*. But such *Springs* as these are very rare, forasmuch as thick *exhalations* do arise with much more difficulty than watry *vapours*, and stand in need of a great degree of heat to raise them to the surface of the *Earth*.

Spring-

II.
Why some Springs flow equally at all times, and others not.

III.
How Fountains of Oyl are generated.





IV. *Why Spring Water is fresh.* Spring-water is generally fresh, without retaining ought of the *saltness* of the *Sea*, whence it is derived.

The Reason is, because the *fresh particles* of the *Sea-water* are most proper for *sublimation*, as being both thin and limber; whereas the *saline particles*, being stiff and hard, cannot be changed into *vapours*, nor pass through the crooked and winding *pores* of the *Earth*. *Fountains* therefore are fresh, because they consist only of those parts of the *water* that have been strained through the narrow *pores* and windings of the *Earth*, or that have been sublimed into *Vapours* by the force of *Heat*.

V. *The Original of Salt Fountains.* There are some *Salt Fountains* in *France*, as near *Caen* and *Bordeaux*, besides several here in *England*; and a great many almost every where upon the *Coast of Africa*; in the *East Indies*, near *Cormandel*, almost all the *Wells* are *Salt*. So likewise in the *Island of St. Vincent*, many of these *Salt Springs* are found: and on the *Shoars of Peru*, several *Salt Lakes*. Besides all these *waters* which had their original, either from an inundation of the *Sea*, or by some inlet from the *Sea*; such is that *Lake in Holland*, commonly called *Haerlem-Meer*. There is also a *Salt Lake* in the *Island of Madagascar*, and in that of *Cuba*, which is 2 Leagues in compass, and is not far distant from the *Sea*. Now the cause of these *Springs* and *Lakes* is, because the passages of the *Earth*, through which their *water* is conveyed, are very large and open, so that very few or none of their *Saline Particles* can be strained from them; or else because their *waters* pass through some *Saline Veins*, and so become impregnated with *Salt*.

VI. *Why some Springs abound with water in the Winter, and in Summer are dried up.* Some *Springs* run copiously all the *Winter* long, but during the heats of *Summer*, their *waters* fail and run no longer.

Such *Fountains* as these, owe their Rise to *Rain* and *Snow*, which supply them with their current. For there are many great *Caverns* under the *Earth*, and especially under high *Hills* and *Mountains*; which being fill'd with *Rain* and *Snow-water*, do, according to their largeness, in a longer or shorter time, exonerate themselves. And thus we find, that after long and continued *Rains*, new *Springs* are seen to break forth; which upon great and long continued *Heat* and *Drought*, are dried up again, until the said *Caverns* be supplied again, and filled by frequent *Showers*, or the melting of *Snow*, and so begin to run as before. Thus we read, that in the time of *Elias the Prophet*, the *Springs* were all dried up; for the *Doors of Heaven* being shut up, neither *Rain* nor *Snow* fell down upon the *Earth*, to supply the continual expence of the said *Springs*.

VII. *Why Rivers cannot run but on a shelving ground.* All *Rivers* have their *Current* from a *shelving ground*, and where they lie upon a perfect level, they continue unmoveable.

The Reason is, as before hath been hinted, because those parts of the *water* that are uppermost, do by their weight press those that lie under them; which being fluid, and readily giving way, slide downwards, where they have more room to spread themselves, and are not so much straitned. For a shelving ground, or down-hill, is, as it were a continued *Range of Perpendicular Lines*, in which the *water* cannot be pressed, but it must fall upon the bottom of the shorter perpendicular. For if

the *Channel*, along which the *Rivers* run, were not shelving, no reason could be assigned, why they should run this way, more than that way; more towards the *East*, than towards the *West*. Moreover, the *Sea*, when it swells with the *Tide*, would be of an equal altitude in the *Rivers*, in case they did run along an *Horizontal Plain*, and not along a shelving ground.

Thus from the *Springs* and *Current* of *Rivers*, we know that some parts of the *Earth* are lower than others. Forasmuch as that part of the *Earth*, to which the *water flows*, is lower than from whence it flows. Hence it is that we know *Bohemia* to be higher than *Holstein*, from the *Current* of the *Elbe*. And thus likewise from the *Danube*, *Visurgis*, the *Rhine*, the *Maes*, &c. we take our *Judgment* of the *Altitude* of the several places through which the said *Rivers* pass. Thus *Switzerland* and the *Country of the Grisons*, are counted by some to be the highest ground of *Europe*, because the *Rhine*, the *Rhone* and the *Danube* proceed from them. Now as great as is the *Down-hill* of these *Rivers*, so great is the altitude of the *Mediterranean* places, above those on the *Seacoasts*.

And the greater the *Down-hill* or *Declivity* of the *Channels* of *Rivers* is, the swifter is their *Current*; and the less it is, the slower is their *Course*. And the same thing is the reason, why one and the same *River*, runs more swiftly in one part of its *Course* than in another, which is observable in many places of the *River Rhine*. For if the bottom of a *River*, within the compass of 200 paces, lean down one pace, the *water* runs so swiftly, that it cannot be navigated without danger. In those places therefore where there are *Cataracts*, or *Downfalls* of *Water*, there the *Rivers* run with the greatest swiftness. And therefore it is that *Brooks* run with that violence, because they are precipitated from the tops of *Mountains*.

All great *Rivers* flow towards the *West*, and none of them towards the *East*.

This hath been generally believed, but without sufficient ground; seeing it is evident, that the *Rhine*, the *Nile* and *Ob* flow towards the *North*; the *Rhone*, and the *River Indus*, towards the *South*; the *Danube*, the *River of the Amazons*, and that of *St. Laurence*, towards the *East*. Whence we conclude, that *Rivers* do not tend to one particular part of the *World*, but are indifferently carried to any part of it.

It is sometimes found that *fresh water* springs in the *Sea*, tho' not far from the *Shoar*. Yea, some *Historians* assure us, that in the *Province of Jucatan*, in *America*, a vein of *fresh water* springs a cubit high, above the surface of the *Sea*.

The reason whereof is, because the *Receptacles* of *water* that are in the neighbouring *Mountains*, have their *vents* or out-lets so disposed, as not to tend upwards towards the top of those *Mountains*, but downwards: So that the *waters* flowing out from them, do meet together with a large *Channel*, where they constitute a *Spring* or *Fountain*; and therefore must needs break forth in some low place, that is, from the bottom of the *Sea*; and because their eruption is forcible, they spring sometime above the surface of the *Sea-water*. The reason why some *Rivers*, running into the *Sea*, do for a great way retain their freshness is, because

VIII. From the Course of Rivers, we know the Altitude of Places.

IX. What is the reason of the swift current of Rivers.

X. Whether the Course of Rivers be always towards the West.

XI. How it comes to pass that fresh water sometimes springs in the midst of the Sea.

their Current is so swift and violent, that they push back the Sea-water, and keep it from mingling with them, till at last, by a longer process, their force being weakened, they mingle with the Salt-water, and are lost in it.

XII.
The Cause
of the con-
stant Inun-
dation of
the River
Nile, after
the Sum-
mer Sol-
stice.

The River Nile, which is but 18 foot deep, doth sometimes swell to the height of 18 Cubits, that is, 27 foot, and at other times to 12 Cubits: And this Inundation is so constant, that it always happens at a set time, that is, presently after the Summer Solstice.

The Common Opinion of the Antients was, that this swelling of the Nile was caused by the anniversary winds, called Etesia, which did blow about that time; and driving against the mouths of this River, did stop the vent of its waters into the Sea, and by consequence made its Channel to swell, and run over its Banks; according to the account the Poet Lucretius gives us of this Inundation, in his 6th Books.

*In Summer Nile o're-flows, his Streams do drown
The Fruitful Egypts Fields, and his alone;
Because the Mouth of that wide River lies
Oppos'd to North, from whence th'Ethiopia's rise
From heavy Northern Clouds, and fiercely blow
Against the Streams; those stop, and rise, and flow.*

But this doth not seem to be the genuine cause of the overflowing of Nile; since it is certain, that the Nile sometimes overflows, before that these soft winds begin to blow, and consequently before they can stop the Mouths of it, in order to cause the said Inundation. And that this overflowing ceaseth, before they cease to blow, and to drive its waters upwards, as is supposed. Wherefore the cause of this Inundation may, with more ground be ascribed to the great and frequent Rains that fall in Ethiopia, from about the middle of June, till September; because the time of their Winter is from the end of May, to the beginning of September. And in like manner, the River Paraguay, or as the Spaniards call it, Rio de la Plaza doth overflow, at the time when great Rains fall on the Mountains of Peru, which obligeth the Inhabitants for 3 Months to live in Boats.

XIII.
What is
the reason
of the sud-
dain rising
and van-
ishing of
some Foun-
tains.

It is observed, that Fountains do sometimes, all on a sudden, break forth on the Mountains, which were never seen before; and that others on the contrary, do as suddenly vanish and disappear.

This sometimes is caused by Earthquakes, whereby the hidden Sources of Springs are broken up, and the obstacles that retain'd and kept them from breaking forth, are removed. And they dry up, and suddenly disappear, when some new obstacles are cast up to stop their way; or when the water is sunk down into such deep Caverns, from whence it can no more be elevated: For in this case it is forced to change its course, and turn aside another way. Who does not know that a vast heap of waters is hid in the hollows of Mountains, which being opened by an Earthquake, way is made for the said waters to break forth?

XIV.
Why some
Rivers run
under
Ground.

Some Rivers, in the midst of their Course, run and hide themselves under ground, and afterwards start up again like new Rivers. Thus the River Niger, in Africa, which some suppose to be de-

rived from the Nile, by a subterraneous passage, by that time it meets with the Mountains of Nubia, runs down under ground, and breaks out again on the West side of the said Mountains.

The Reason of this is twofold. 1st. The obstacle of a higher ground than is the bottom of the River. 2^{dly}. The Hollow that is under the ground, at the place where the River hides it self, or the looseness of the ground, which easily gives way to the force of the River. Thus the River Tigris, in Mesopotamia, after it hath passed the River Arcthusa, meeting with the Mountain Taurus, runs down into a Cave, and riseth again on the other side of the Mountain; and afterwards having passed the Lake Thepsis, hides it self again under ground, and riseth up again about 6 German miles farther.

CHAP. V.

Of the Sea.

THE great Mass of the Waters of the Sea, appears higher than the Earth, and seems to be raised much above the surface of it. And therefore to those who take a prospect of the Sea, from the Shoar, the Sea seems higher than the Land; and when from the Sea, they look to the Shoar, that appears lower than the Sea.

Some persons, measuring all things by their Eye-sight, suppose the Sea, because of the same convexity it hath with the Earth, to rise by degrees above the Earth; and that it is not only higher than the ground or bottom of the Earth that supports it, but is also higher than the Islands and Continents. But this is no better than a deception of the sight, which reaching forwards towards the more remote parts of the Sea, is directed towards them by Rays, which the more they recede from a Perpendicular, the further distant and higher it represents them. This we find by experience, not only in the Sea, but in any great Plain. And on the other hand, the reason why the Shoar, beheld from the Sea, appears lower than it, is because the height thereof is contained in the least Visory Angle, which the Rolling Waves do intercept, and take away the sight of; so that it is no wonder if the Shoar seems to be more depressed than the Water.

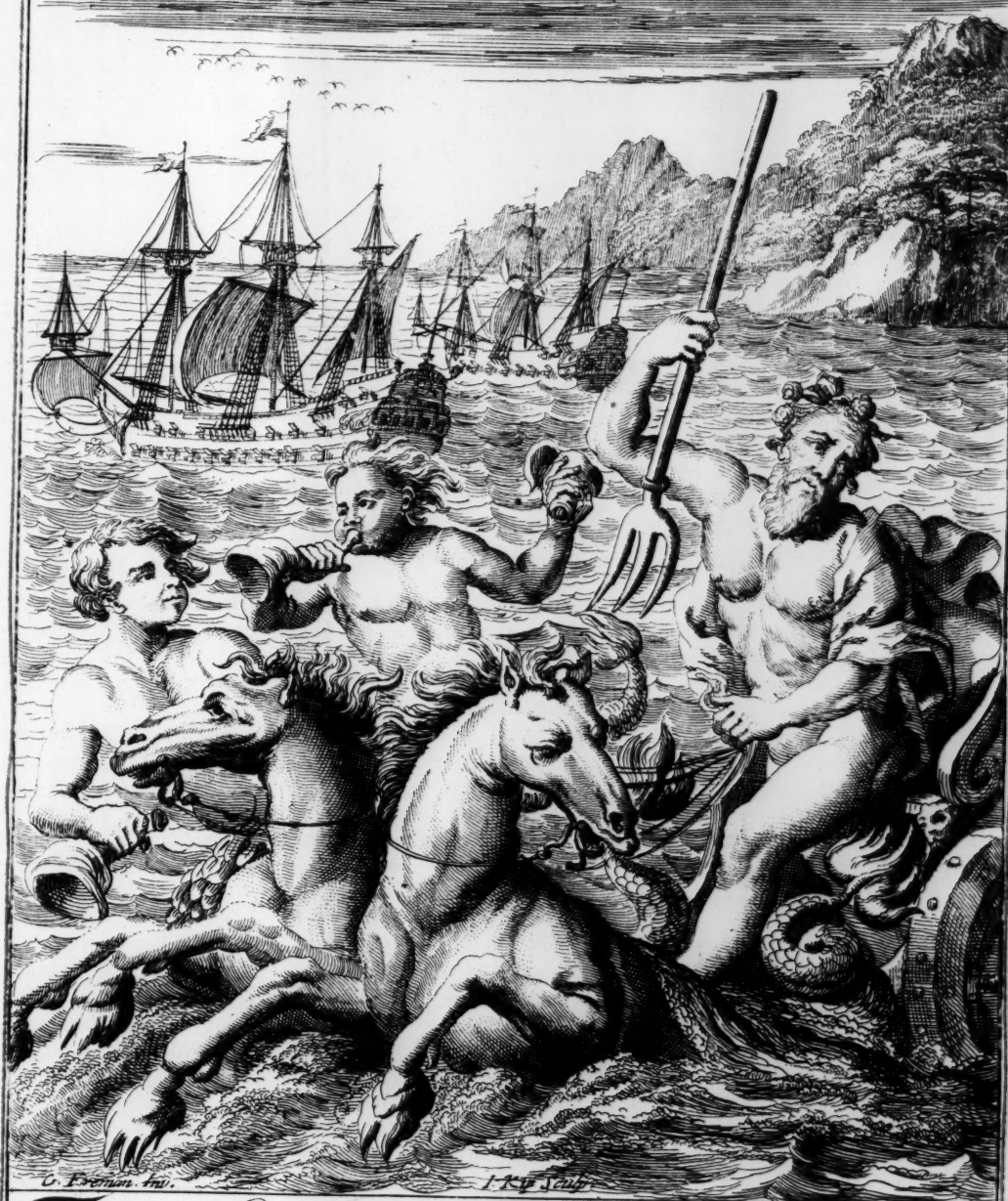
But besides this, we have a very convincing Argument to prove, that the Sea, setting aside the swelling of its Waves, is not higher than the Earth. For this supposed, it must follow, that the Water, by its natural gravity, would overflow; and quitting the upper part of the Earth, would only take up the lower. Or so far as the parts of the Water do push forwards one another, and the upper parts press those that are under them, the whole surface of the Earth would presently be covered by them, and both Islands and Mountains be overwhelmed by the Sea. Besides, how would Rivers be able to return to the Sea, if the Sea were higher than the Earth; and if the surface of the Earth were lower than that of the Sea? For nothing that is heavy does naturally tend upwards, as every Body does that tends to a Body, that lies higher than it self.

I.
Why the
Sea seems
to be higher
than the
Earth.

II.
That the
Water is
not higher
than the
Earth, pro-
ved.

And

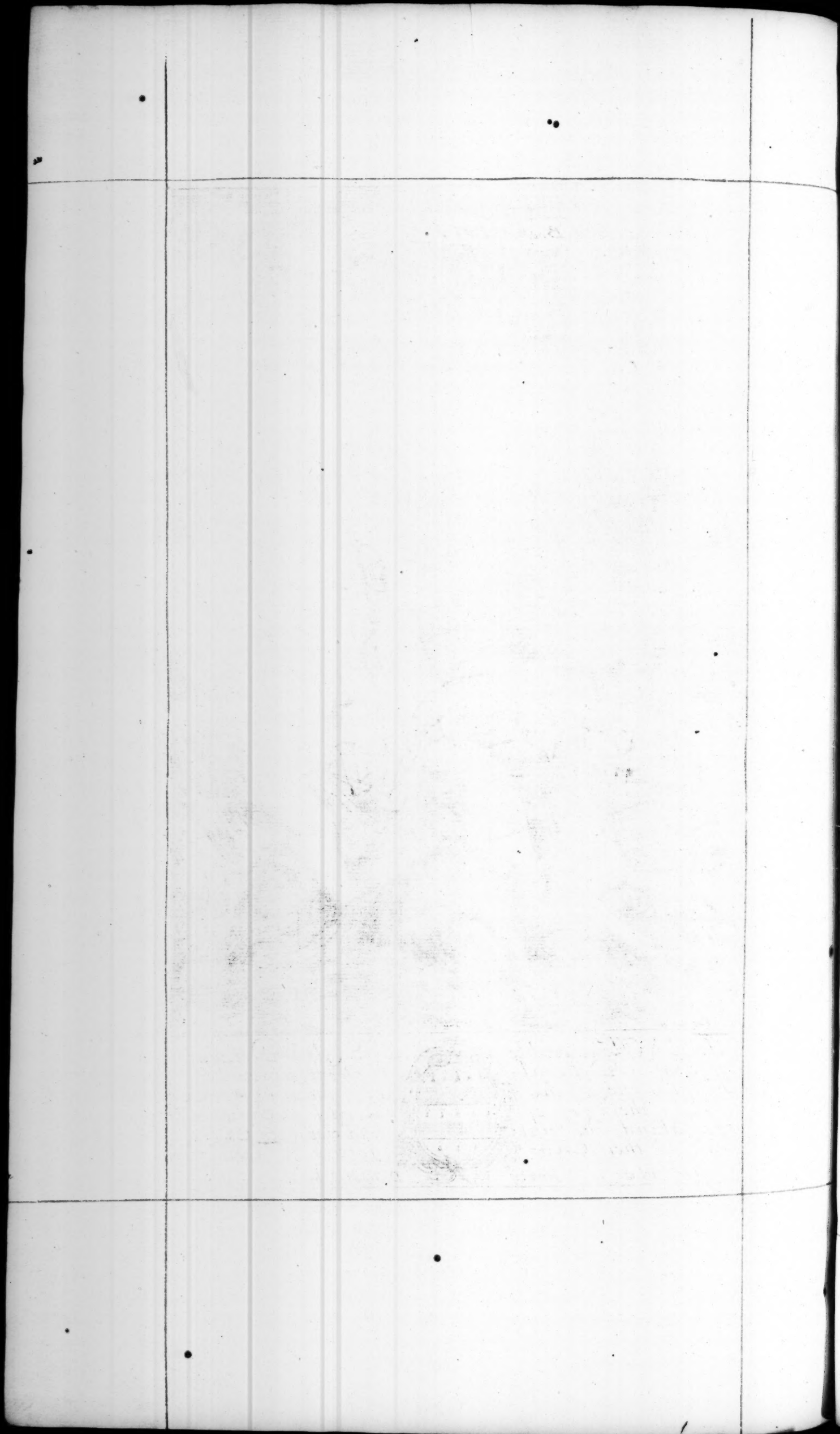
Book. 2. Part. 4. Chap. 5.



To the Honourable
of Seaton-Delaval
Knight, one of the
executing the Office of
of England; and joint
rall of their Ma-



S^r Ralph Delaval,
in Northumberland
Comissioners for Ex=
Lord high Admirall
and Seperate Admi=
jesties Fleet.
Dedicated, by Richard Blome.



III.
The Red-Sea is not higher than the Mediterranean.

And therefore it was a vain Fear into which the *Mathematicians* cast the *Kings of Egypt*, when they dissuaded them from cutting a *Channel* from the *Red-Sea* into the *Nile*, or the *Mediterranean*; supposing the *Red-Sea* to be 3 Cubits higher than the *Mediterranean*, and that therefore a *Deluge* would be the consequent of that Enterprize. For indeed, had the *Red-Sea* been only one Fingers-breadth higher than that part of the *Mediterranean* which washeth the Shoars of *Egypt*, the whole compass of *Africa*, would not hinder it from running thither, till both Seas were reduc'd to a Level. Thus, because the *Caspian Sea* is higher than the *Euxine*, therefore it empties it self into it: And because the *Euxine-Sea* is higher than the *Ægean* or *Archipelago*, therefore it falls down into it.

IV.
Aristotle's Mistake about the height of the Sea.

This discovers *ARISTOTLE's* Error, who asserts the *Ocean* and the *Earth*, to be higher toward the *North*, than about the *Equator*; because the *Ocean* seems to flow from the *North* parts of the *World*, as from its Head or *Fountain*. But indeed, nothing of certainty can be thence infer'd: For it is doubtful as yet, and hath never been sufficiently proved, neither from that motion can it sufficiently be cleared, whether the *Northern Countries*, and more particularly the *Channels* of *Northern Rivers*, be higher or lower than the *Channels* of those that are about the *Equator*. The Reason is, because this motion is not General or Universal, as not being found in all *Northern Countries*. And tho' we should grant this motion of the *Ocean* from the *North*, yet doth it not follow from thence, that the *Ocean* there is higher, because it is to avoid this greater height, that the *Sea* flows from the *North* towards the *Equator*.

V.
Why a Ship cannot without difficulty be brought out of the Haven into the Sea.

But some Body may Object: If it be so that the *Sea* is not higher than the surface of the *Earth*, how comes it to pass, that it is more hard to get *Ships* out of the *Haven* into the *Sea*; than it is to enter into it from the *Sea*?

I Answer, That the Reason of this is, not because the *Sea* is higher than the *Earth*; but because when a *Ship* is getting out of the *Haven*, it hath but little *Wind*, because the *Shoars* and *Banks* break the force of it, and hinder it from rushing with a full swing against the *Sails*. Whereas, when a *Ship* enters the *Haven*, nothing hinders the *Wind* from coming with full force against them.

VI.
How it comes to pass that the Rivers return to the Sea.

Rivers continually exonerate themselves into the *Sea*, and having pass'd through several Tracts of the *Earth*, return to it again; and yet the *Sea* is never increased by this accession of the *Water* of innumerable *Rivers*, that continually, without ceasing, run into it.

The Cause hereof is, that continual Change, whereby the *Sea-water* is turned into *Vapours*, and they again changed into *water*. For as we see in an *Animal*, that the *Blood* runs out of the *Hollow Vein* into the *Heart*, and presently after is from thence dispersed through the *Great Artery*, to all the parts of the *Body*: So the *Vapours* arising from the *Sea*, are convey'd through the Passages of the *Earth*, to the tops of *Mountains*, and there being condensed by the Coldness of the place into *water*, become *Springs*, and afterwards *Rivers*; which through the slanting places of the surface

the *Earth*, are carried again towards the *Sea*, which is the place from whence they first proceeded: So that as much *water* as is thus evaporated from out of the *Bowels* and *Caverns* of the *Earth*, so much flows into them again from the *Sea*; and as much as runs from the *Sea* through these *subterranean Passages*, so much the *Rivers* return to the *Sea* again.

Neither is it any matter of wonder, that the *Water* of the *Sea* continues salt, notwithstanding she receives the *Fresh-water* of so many *Rivers* into her Bosom: And so much *Salt-water* continually flows from her into the *Bowels* of the *Earth*, and which leaves its *Salt* in the places where they are distill'd into *Vapours*. For besides that the *Sea-water* may be convey'd into the *Earth* to those places where it is thus distill'd, by such large and open Passages, that the *water* which is left after the *Evaporation*, may carry back all the *Salt* which it could not elevate, into the *Sea*; the *water* which runs continually through the *Mines* of *Salt*, do carry along with them at least as much of it to the *Sea*, as the *Sea-water* conveys into the *Bowels* of the *Earth*: Whence it is evident, that the *Sea* must always keep its saltness, as we see it doth.

In the Heat of *Summer* the *Sea* is found by Experience to be *Salter*, than at other times: Which they who live under the *Equator* and *Torrid Zone* are very sensible of.

The Reason is, because the *Sun*, which is extream hot in those parts, doth evaporate the thinner and fresher parts of the *Sea*, leaving the more thick and gross parts behind. And the more vehement this heat of the *Sun* is, the more are the outward parts of the *Water* agitated, and a greater abundance of *Vapours* are sublim'd; which being condensed in the *Air*, and reduced again to *water*, do not always fall down in the same place from whence they proceeded; but frequently having taken a large turn in the *Air*, fall down to the *Earth*, at a great distance from the place of their first elevation. An Example whereof we have in *Salt-water* that is boyled over the *Fire*, which the longer it is boyl'd, the *salter* it grows; because the fresh particles are continually exhaled from it.

Hence it is that our Modern Physicians suppose our *Spittle* to be salt and sourish; for when we spit upon a hot *Brick* or *Iron*, it leaves a white Spot behind it, which is nothing else but a collection of *saline particles*, that because of their Stiffness and Heaviness, could not fly away together with the watry particles.

The Reason why the *Sea* is more salt betwixt the *Tropicks* is, because the *Sun* dispenseth more heat towards the *Equinoctial Line*, than in places at a farther distance from it, and consequently resolves more of the *Particles* of fresh *water* into *Vapours*, and by the extraction of them leaves the *Sea-water* *salter* than it was before. To which may be added, that the *Sea* is of a far greater extent between the *Tropicks*, than in the *Frigid* and *Temperate Zones*, and less *Rivers* empty themselves into it.

And from hence we may easily perceive the Reason, why the *water* of the *German Ocean*, and of other parts of the *Northern Sea*, is not so good to be boiled into *Salt*, as is the *water* of the *Spanish*

VII.
Why the Sea always preserves the same degree of saltness.

VIII.
Why the Sea is found to be more salt in the heat of Summer.

IX.
How it may be prov'd, that our Spittle is salt.

X.
Why the Sea is more salt betwixt the Tropicks, than elsewhere.

XI.
Why Sea-water near the Equator is more proper for Salt, than others.

Spanish Sea, the *Canary Islands*, and *Cape Verd*, or the *Green Promontory* in *Africa*; viz. because these last parts of the *Sea* are nearer to the *Torrid Zone*, and receive its *waters* from the *Ocean* of that Place. But yet it cannot be deny'd, but that some of these *Seas* are more proper for the making of *Salt*, than others. Thus the *Sea-water* that is upon the Coast of *Guinea*, in the *Ethiopick Ocean*, doth at one boiling afford a *Salt* as white as *Sugar*, such as neither the *Spanish-Sea*, nor the *Sea-water* of any part of *Europe* can afford at the first boiling.

XII.
How Sea-
water may
be made
fresh.

Dig a *Pit* on the *Sea-shoar*, a little higher than the *Tide* reacheth, and as deep as the lowest *Sea-mark*; and when the *Tide* comes in, you'll find it fill'd with *Fresh-water*. This is an Experiment commonly try'd by the *Inhabitants* of the *Sea-Coast* of *Barbary*, who have little other *Fresh-water*, but what they get after this manner.

The Reason of this Experiment is, because the *Sea-water* loseth its *saltness* by straining through the *Sand*, between which it leaves its *Corner'd* parts, which are the cause of its *saltness*. But yet it is not necessary, in order to the ridding of *Sea-water* from its *saltness*, that the *pores* through which it is strained, be extream strait and narrow; for if they were so, they would presently be stop'd up, by the first *saline Particles* that entred them, and so there would be no way left for the *particles* of the *Fresh-water* to pass. But it is rather necessary, that the *Sea-water* be strained through those *Bodies*, whose *pores* are large enough, and full of *Corners* and *Windings*, proper to stop the *particles* of *Salt* from running along with the *Fresh-water*. It is also necessary, that the *Body* through which it is strained be large enough, that so, since it can rid it self of the *Salt* all at once, it may have a sufficient space to drain through, to rid it self thereof by degrees, by passing through the several *Crook'd* windings of it; and therefore some time is required, before the *Sea-water* can pass through that space, which is necessary by filtration to separate its *Salt* from it.

XIII.
Why the
Sea-water
is salt.

Reasons may also be assigned, why it pleas'd the *Creator* of all Things that the *Sea* should be salt; viz. 1st, That it might not be apt to putrify, corrupt and stink. 2^{dly}, That the *Sea-water* might not be so easily resolv'd into *Vapours*, as the *Fresh* is, by reason of the *Heaviness* the *Salt* imparts to it. 3^{dly}, That the *flesh* or *substance* of the *Fishes*, that breed and live in it, might be the firmer. 4^{thly}, That it might be the more able to resist the violence of *Winds* and *Storms*. For *Salt-water* is more firm and consistent, than *Fresh*. 5^{thly}, That it might be the better able to resist cold, and not be so easily frozen, as *Fresh*.

XIV.
Why the
Water of
the Sea
runs West-
ward.

Constant and known Experience hath informed *Sea-men*, that the *Sea* moves from East to West: So that by this means *Ships* have a shorter or more speedy Navigation to the *West-Indies*, than to the *East*. And all Navigations to the *East*, are found more difficult, and take up more time.

This proceeds from the *Inequality* of the parts, whereof the *Earth* and *Water* do consist. For tho' this *Terraqueous Globe*, by its Diurnal motion, moves from *West* to *East*, about its own *Center*; yet because the *Earth* is more solid and heavy than the *Water*, therefore it is whirl'd about its

Center more swiftly, than the *water*: So that the *water*, which is more slowly carried about, seems to move towards the *West*; in like manner as a *Boat*, that moves more slowly towards the same place, appears to tend the quite contrary way to another *Boat* that moves more swiftly.

This motion of the *Sea-water* from East to West, is most perceived between the *Tropicks*, and in the *Torrid Zone*; because tho' the *Earth* be *Spherical*, yet because that part of its Roundness which is between the *Tropicks*, is whirl'd about with the greatest force towards the *East*, as being furthest from the *Poles*; whereas that part which is without them, because of its nearness to the *Poles*, is moved more slowly, therefore it is that this motion is only perceptible between the *Tropicks*.

XV.
This motion is only perceptible between the Tropicks.

Besides the General motion of the *Sea*, which belongs to the whole *Mass* or *Body* of it, there are also several particular motions observed in it, which are called *Currents*; whereof some happen constantly at certain Seasons of the year, but others are not subject to any fixt time. They that Sail to the *East-Indies*, observe some very swift *Currents* in their way thither: For tho' the *Tide*, in those *Seas*, do not rise above 2 or 3 Feet; yet they extend themselves the space of 12 or 13 Hours towards the *North*, and the rest towards the *South*, with such an extream Violence, that it sometimes breaks the strongest *Cables* of *Ships* lying at *Anker*.

There be 2 sorts of these *Currents*, the one constant and fixt, the other inconstant and irregular. It seems probable, that the constant *Currents* that are observed between the *Tropicks*, do proceed from hence, because the *waters* that run Westward, are more strained in some places, than in others; either because the *Bottom* of the *Sea* is more deep there, or because of a range of *Rocks* in *Parallel Lines*, which oblige them to follow their direction. And as to those *Currents* that are found without the *Tropicks*, and which continue always the same, it is very likely that they proceed from some *Rivers*, which continually discharge themselves into the *Sea*. For as there are some *Rivers* which appear above the *Earth*; so there are others also that lye hid, and which flow beneath the surface of it.

XVII.
The Cause of certain and fixed Currents.

As to those *Currents* which are Incertain and Irregular, both as to the time, and the determination of their motion, they seem to be caused by the Unevenness of the *Bottom* of the *Sea*, by reason of divers *Rocks* ranged in *Lines*, differently tending towards the 4 Principal parts of the *Horizon*. For this supposed, whenever there is a stiff Gale of *Wind*, it must needs drive the *water* forcibly between these *Rocks*, and by so doing must force them to take a Course by so much the more violent, as the *Wind* is stronger, and the space betwixt the *Rocks* straiter.

XVIII.
The Cause of inconstant and irregular Currents.

The *Sea-water* doth more powerfully resist the *Bodies* that are put into it, than *River-water*: As we see that sometimes those *Ships* which were born up by the *Sea*, do sink in the *River* or *Haven*.

XIX.
The Sea-water can bear more heavy burdens, than the Fresh-water.

The Reason is, because the *water* of the *Sea* is more heavy, as consisting of more thick and solid Parts, and which may lye in a less room, and therefore are more able to bear the burdens put upon

upon them. This is most evident in the *Dead-Sea*, which because of its extream *saltness*, will buoy up a Man, that is cast into it with his Hands and Feet bound. *HIERONYMUS FLORENTINUS* relates, that he saw a Man that was cast headlong, bound *Hands and Feet*, into the *water*, yet was kept up by it for a whole Night: And *POSSIDONIUS* affirms, that he saw in *Spain*, Tiles made of an *Earth* wherewith they scour *Plate*, swimming on the top of the *water*. Neither can any other Reason be given, why a *Ship* draws more *water* when she Rides in an *Haven*, than at *Sea*; but because the *water* in the *Haven* is not so *salt* as the *Sea-water*, and therefore doth not buoy up the *Vessel* so strongly, as the more *Salt-water* of the *Sea*.

XX. Why Wine through a Flannen-Bag, or Linnen-Bag, of a Conical figure, loseth its strength.

This also is the Reason why *Wine* that is strained through a *Flannen-Bag*, commonly called *Hippocrates his Sleeve*, doth lose the greatest part of its strength; because many of those *particles*, wherein the strength of the *Wine* doth consist, do continue sticking in the *pores* of the *Filter*, by which means the *Wine* being deprived of them, proves much more weak than it was before.

XXI. Salt-water is not good to quench Fire with, for it rather promotes it.

The Reason is, because the *particles* of *Salt*, which predominate in *Salt-water*, being *stiff* and *inflexible*, are easily agitated by the *Bodies* they meet with; and being thus agitated, are very proper to increase the *Flame*, seeing that of themselves they oft produce a *flame*, when at any time they break forth violently from the *Bodies* in which they are contained. To this may be added, that the *Sea-water* is much thicker and fatter, than *Fresh-water*, and so is more proper to feed and foment the *flame*, than to extinguish it. It was by this means that the *Fire-works* cast into *MARK ANTONY's Fleet*, in the *Sea-fight* at *Actium*, did much greater Execution, because the *Souldiers* not understanding the Nature of *Sea-water*, endeavouring to quench the *Fire* kindled in their *Vessels*, by pouring *Sea-water* upon the *flame*, did thereby strengthen and increase it.

XXII. When Fire hath got the Mastery, it is rather increased by pouring a little Water upon it.

Yea, it may be observed, that tho' *Water* be very contrary to *Fire*; yet there be some *Bodies*, which after they have *water* cast upon them, do flame so much the more. And therefore it is that *Smiths* sprinkle *water* upon their *Sea-Coal*, to make them burn the more violently. And nothing is more evident, than that a small quantity of *water* cast upon a strong *flame*, doth but augment it. But *Salt-water* doth this with greater efficacy, because of the stiffness of the parts of it, which darting into the *flame* like so many little *Arrows*, and hitting against other *Bodies*, have a great force to shake and agitate them: Which is the Reason why *Salts* are made use of for the melting and solution of *Metals*.

CHAP. VI.

Of the Ebbing and Flowing of the Sea.

I. The Cause of the Ebbing and

The *Sea*, in the space of 24 *Hours* and almost 50 *Minutes*, does flow and ebb twice. The Cause of this wonderful Effect, is ascribed

to the *Body* of the *Moon*, which by pressing the *Matter* that runs between her and the *Earth*, doth drive the *water* also towards the *shoars*. For as that part of the *Street* is made more narrow, which hath some part of its breadth taken up by some thick *Body*; and as that *Wind* is the strongest and most forceable, which passeth through a narrow place; so likewise, because the presence of the *Moons Body* doth streighten the space that is between her and the *Earth*, the *Air* and the *Water*, which are *fluid Bodies*, must needs give way, and rise higher towards the *shoar*. In the very same manner as we see, that *water*, or any other *Liquor*, poured into a *Vessel*, riseth about the sides of the *Vessel*, if it be prest by any thing, and leaving the middle of it, is carried towards the *Edge* of it. But to clear this yet further, let us suppose *T* to be the *Earth*, and *E F G H*, the *water* which compasseth the *Earth*; *B*, the *Moon*, running through her *Circle* in a *Months* time; *N O P Q*, the *Vortex* of *Heaven*, which hath the *Earth T* for its *Center*, and which together with the *Moon* is continually whirled about the *Earth*. For the same *Heavenly matter* which tends to *O*, and thence continues its course to *P* and *Q*, requires as much space on one side of the *Earth*, as on the other, and so would prest it every where alike. But because the *Moon* is at *B*, and doth not move so swift as the *Heavenly matter*; therefore the said *Matter* cannot but prest the *Earth* more towards *P*, than towards *O* or *Q*, and consequently the *Earth* must remove a little from the *Center* of the *Vortex*, and come nearer to *D*; and by this means deprest the *water* which is at *F* and *H*. Moreover, because the *Earth* is whirld in 24 *Hours* about its own *Center*, that part of it which is now at the Point *F*, where the *Sea* falls, within 6 *Hours*, will be at the Point *G*, where the *Sea* swells; and after 12 *Hours* at the Point *H*, where it falls again. And forasmuch as the *Moon* all this while makes some small progress also, and finisheth her Circumvolution about the *Earth* in the space of almost 30 *Days*, we must add 12 *Minutes* of an Hour to the time of each Ebbing and Flowing; so that the *Sea* takes up 12 *Hours* and 24 *Minutes*, in her Ebbing and Flowing, at one and the same place.

Whence it is evident, that this motion of the *Sea* must be attributed to the *Moon*; seeing that we find, that the *Tide* riseth every Day one Hour later, according to the motion of the *Moon*. For suppose we the *Tide* to come in to day at 12 of the *Clock*, to Morrow it will not begin till One, which is a sufficient Argument, that the *Tide* proceeds from the *Moon*.

The *Tide* doth not always observe the same time, but comes to some *Shoars* sooner, and to others later.

This difference may proceed from many Causes; but chiefly from the unevenness of the *Bottoms* or *Channels*, wherein the *waters* are contained, or from the situation and disposition of the *shoars*, by which the motion of the *water* is much advanced or hindred. Whereof we have an Instance in the *Banks* of *Rivers*, between which the *water*, according to the diversity of their situation, either runs headlong, or flows gently; goes winding, or else strait along.

6 L

Hence

Flowing of the Sea, is the Moon.

Figure 46. in the Institution.

II. The Moon is the Cause of this Rectification.

III. Whence the great difference of the Tides doth arise.

IV.
What is
the reason
of the great
Tides that
are one the
Coasts of
Normandy.

Hence it is also that they have such great *Tides*, on the Coasts of *Normandy* and *Britanny*, so as that about *S. Michael*, and *S. Macluo*, the *Tides* rise sometime above 60 Foot high. For the *Sea* being driven from *South* to *North*, are beaten back by the *British Shoar*, and afterwards rebounding from the Coasts of *Normandy* and *Britany* they joyn in one *Angle*, and because of the narrowness of the place do swell and encrease.

V.
The flow-
ing of the
Sea tends
at the same
time from
the East
to the West,
and from
the Trop-
icks to
the Poles.

The *Tide* doth not only tend from *East* to *West*, but also at the same time from the *Tropicks* to the *Poles*: But yet so, as that in certain places, the one of these is greater and more sensible than the other, which depends on the position or direction of the Coasts. As for Example, in the *Atlantick Ocean*, the *Tide* seems only to tend from the *Tropicks* to the *Poles*, and this because the Coasts of *America* do resist its motion from *East* to *West*. But on the contrary in the *Magellan Straits*, no other motion is perceived but from *East* to *West*; because the Coasts there resist the motion from the *Tropicks* towards the *Poles*.

VI.
Why there
is no Tide
in the Me-
diterrane-
an.

The Reason why only a very small *Tide*, or none at all is perceived in the *Mediterranean* is, because it contains many *Islands*, which resist and hinder it, as also because of the narrowness of its *Channel*, which does not afford the waters room enough to display themselves in. For tho' that part of the *Mediterranean*, which is beyond the *Tropicks*, hath intercourse with the *Ocean* by means of the *straits* of *Gibraltar*; yet because that passage is not above 3 or 4 *Leagues* over, all the water that can enter this way within the space of 6 *Hours*, is very inconsiderable, if considered with the height and breadth of that *Sea*. And moreover, as soon as the water is entred, it finds the *Sea* broad, and the *Shoars* so disposed, that it only moves along the *Shoars*; and therefore it is necessary, that there be only a continual course of the water, without any *Flood*.

VII.
Whence the
Tide pro-
ceeds, which
is found in
the Gulf
of Venice.

But yet we must here except the *Gulf of Venice*; for seeing that the waters that are there, being beaten back from the Coasts of the *Morea*, do soon reach the end of that *Channel*; it must needs follow that because the first rebounds are seconded and supported by the latter, they must cause a sensible *Tide*, as experience doth witness they do.

VIII.
On the Coast
of Provence
there is but
a small
Tide.

On the Coast of *Provence* in *France*, a small *Tide* only is observed, especially at the *New* and *Full Moon* of the *Aequinoxes*; for seeing that from that *Shoar*, to the opposit Coast of *Africa*, there are almost 8 *Degrees* of *Latitude*, without any *Island* lying between; and because it hath an open way from *South* to *North*, the *Sea* there, about the *Aequinoxes*, flows about 2 Foot high.

IX.
Why there
is no Tide
in the
North Sea.

So likewise in the *North Sea* beyond *Scotland*, towards *Norway* and *Greenland*, scarcely any *Tide* at all is observed, because that part of the *Earth*, is at a great distance from the Tract the *Moon* moves in; or because that *Sea* is extended from *West* to *East*, and is interrupted with many *Islands*, and jetting Points of *Land*: Whereas in *Hudsons Bay*, a great *Tide* is observed, because that *Sea* lies open from *East* to *West*.

X.
Why the
Tide varies
in some
places.

And much a like account must be given, of that great variety of *Tides* observed in other places, for that the *Sea* flows many Foot high at *Venice*, and at *Ancona* riseth but little or nothing at all;

that on the Coast of *Syria*, it flows much higher, than in several parts of *France*, where it scarcely riseth 1 Foot high; the reason of this is, because the Coast of *Syria* is at the end of the *Mediterranean Channel*, and those of *France* about the midst of it; as we find in a *Boat*, that the rising and falling of the agitated water, is only perceived in the extreame parts of it, not about the midst, where the water is smooth and even.

Accordingly also, a Reason may be given why the *Tide*, in the *River* of *Garonne* in *France*, flows almost 120 *Miles*, in the space of 18 *Hours*, whereas the ebbing is performed in 12 only. For if the motion of this *Tide* be exactly Calculated it will be found, that if the *Flood* comes in at the *New Moon* at 3 of the Clock at *Midnight*, it will proceed almost 50 *Miles* in 6 *Hours*, that is, by 9 a Clock in the Morning; and afterwards in so many *Hours* more, will come to *Bordeaux*, and at 3 a Clock in the Afternoon it turns the *Ships* about, which shews that the *Tide* is coming in: And then at 9 of the Clock it reaches as far as the Town of *S. Merceur*, but is very weak and small there; and without making any stay there, is presently followed with the *Ebb*, which it is evident must not take up so much time by 6 *Hours* as the *Flood* did; because the water by its innate heaviness runs more swiftly to the *Sea*, than from the *Sea* into the *Rivers*. For the *Sea* being low, and much deeper than the *Rivers*, it cannot be otherwise but that the further the *Tide* reacheth up in *Rivers*, the more slow must its motion be, because it mounts all the way, and moves uphill. For the flowing of the *Tide* continues, till the water of the *Rivers* and of the *Sea* be of one and the same height.

Havens that are under the same *Meridian*, have not always their *Tides* at the same time, as is evident in that famous French Haven of *Havre de Grace*, which at the *Full* and *New Moon* hath high water at 9 a Clock in the Morning; whereas at *Diep* it is not high water till 10 a Clock, tho' these *Havens* be but at a little distance from one another, and scarcely differ half a Degree.

The reason hereof is, the many windings and turnings that are in the *Channel*, which change and turn the course of the water: As likewise the violence of the *Winds*, which is very considerable there. Thus at *Calice* and *Sluys* in *Flanders*, at *Full* and *New Moon* it is high water, about 11 a Clock, the *Moon* being enlightened on that part which looks Southward; at *Armmuyden* and *Mid-delburg*, at 2 a Clock in the Afternoon or Morning; at *Zierick-zee* at 3 a Clock when the *Moon* is at *South-west*, and the *Sun* enters *Capricorn*; at *Bergen* 2 *Hours* and an half later; at *Antwerp* and *Dort*, the *Moon* being turned toward the *Aequinoctial West*, almost at 6 a Clock; at *Mechelen* at 8, but yet so as that the *Tide* sometimes comes in faster, and at other times slower, according as the Weather is Fair and Calm, or Stormy.

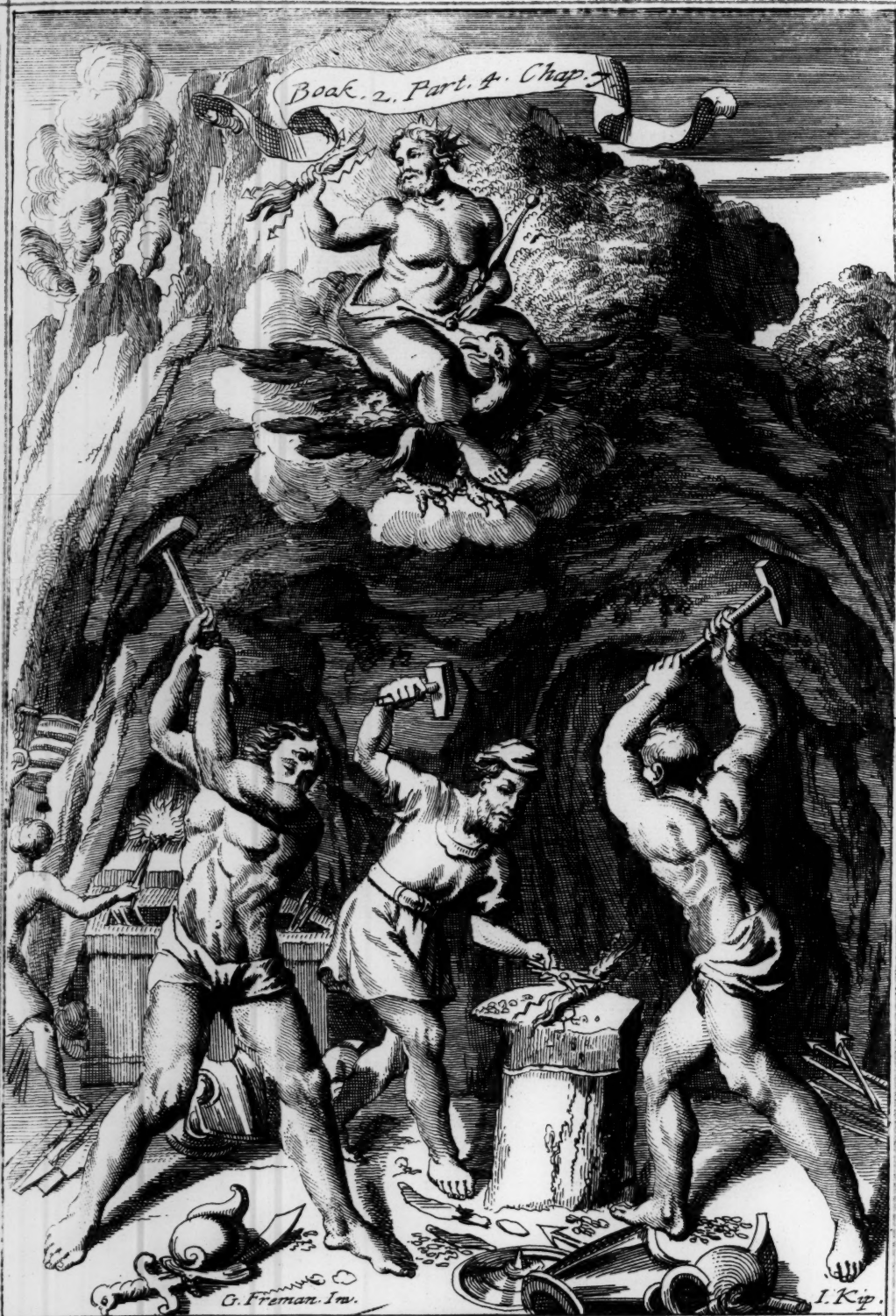
The greatest *Tides* are at the *Conjunctions* about *D*, and at the *oppositions* about *B*, that is, at the *New* and *Full Moon*, than at the *Quarters*, or *Quadrant Aspects* at *A*, and *C*. And therefore the *Sea* men at the *New* and *Full Moon*, because the *Tides* are then greater and swifter, call it a *live Sea*, and at the *Quarters* a *dead Sea*.

XI.
The Sea
water some-
times takes
up more
time in
flowing
than in Eb-
bing.

XII.
Why the
Tide at
Havre de
Grace in
France
does set
sooner at
the Full
Moon than
at *Diep*.

XIII.
The Tides
are greater
at the New
and Full
Moon than
at other
times.

The



To the Right Hon.^{ble} Henry Lord
Baron of Milton, L.^d Lieutenant of
Lord Warden of y^e Cinqueports
nance, Collonel of their M^{ties}.
one of the Gentlemen of
and one of the Lords of
Honourable privy



Viscount Sydney of Shephey,
Kent, Constable of Dover Castle,
M^r. Generallof their M^{ties}. Ord-
first Regiment of foot Guards,
his Majesties Bedchamber,
their Majesties most
Councell &c.^a

This Plate is humbly

Dedicated, by Richard Blome.

The Reason is, because the *Heaven* A, B, C, D, is not of a *Spherical*, but almost *Elliptical* figure, and hath more room in that part of it, which is between the *Earth* and A, C, than in the opposit part about B, and D. Now seeing that the *Moon* when she is about the *Quarters*, moves in these larger spaces, she consequently advanceth more slowly, and so presseth the *waters* less, and causeth a less *Tide*. Whereas at the *New* or *Full Moon*, she moves in the narrowest part of her *Ellipsis*, and therefore causeth a greater pression of the *waters*, and a greater and swifter *Tide*.

It is for the same Reason, that 3 great *Tides* are observed in the *River Seine* in *France*, about the *Equinoxes* and *Solstices*: For the 1st of them riseth almost 4 Foot high, the 2^d 8, and the 3^d 12 and upwards, and that with so great swiftness, that in 4 *Hours* it advanceth 25 french Leagues with a great Noise. For seeing that the *Tides* exceed about the *Equinoxes*, and about the *Full* and *New Moon*, the motion of the *waters* must be greater also; and seeing also that the *Channel* of the *River Seine* with respect to its Mouth, where it enters the *Sea*, doth resemble a *Trumpet*, which grows narrower and narrower by degrees, it cannot be otherwise, but that the *waters* mult rush in with a great force into such a narrow *Channel*.

The *River* or rather the narrow *Sea Euripus*, if we may believe the *Antients*, *Ebbs* and *Flows* 9 times a day.

The cause of this effect may also be ascribed to the Interposition of the *Moon*, by the pressing whereof the *River* runs down, not towards one part of the *World*, as the *Seas* do, but every way; so as that one part goes to the *South*, another to the *North*, &c. which as they light upon the *Straits* of a narrow *Sea*, or upon neighbouring *Shoars*, accordingly the *Ebbing* is hastned or retarded. Tho' indeed we may have good reason to question, whether what the *Antients* have related of this *River*, be all agreeable to Truth; seeing that *TITUS LIVIUS* in his 8th Book, Decad 3^d denies it, and gives us sufficient occasion, to doubt of the faithfulness of *Authors* as to that Point. The *Strait of Euripus*, saith he, doth not ebb and flow at set times 7 times a day, as the common report is, but according to the *Wind* is sometimes hurried this way, and sometimes that way, like a *Brook* that falls headlong from a steep *Mountain*; so that it does not suffer the *Ships* to rest night or day.

Rivers and *Lakes* have no *Tides*, and receive no change from the opposition of the *Moon*.

The Reason is, because their *Banks* are not sufficiently distant from one another, nor is their surface large enough to admit the pressure of the *Heavenly matter*. For even as *Vessels* the narrower they are, the less motion is perceived in them; so no other *water*, but the *Sea* which surrounds the whole *Earth* can have so much room, as at the same time to rise or swell in 2 several places, and to fall or sink in 2 others. And therefore it is that the *Rivers*, *Bays* and *Lakes* that are between the *Tropicks*, cannot admit of any *Ebbings* and *Flowings*.

As to those *Lakes* and *Rivers* that are without the *Tropicks*, neither are they subject to *Tides*, nor the *Seas* neither, that are considerably

great, in case they have no intercourse with the *Ocean*, or if they have any, yet the communication of the *waters*, is by a strait and narrow passage. Thus the *dead Sea* in *Asia*, and the *Euxine Sea* in *Europe* have no *Tides*, because they have no communication with the *Ocean*; neither hath the *Baltick Sea* any, for tho' it be united with the *Ocean*, yet the strait of the *Sound* by which it communicates with the *Ocean*, is so far turn'd aside, from the *Straight Line*, in which the *waters* move that are driven from the *Tropicks* towards the *Poles*, that they cannot enter in sufficient quantity into it, within the time of 6 *Hours*, to cause any sensible Elevation of the *waters*.

C H A P. VII.

Of Fire.

ONE Fire is produced or propagated by another.

The Reason hereof is, because the parts of the 3^d Element, being carried away by the *First* that surrounds them, meet with like parts of the 3^d Element, which they not only separate from their like parts, but also from those of the 2^d Element, so that these also being surrounded with the *first*, are snatch'd away by it. For as a *Ship* that is carried along by the stream of a *River*, doth more forceably push forwards other *Bodies* it meets with, than the *River* it self can; so these parts of the 3^d Element, being hurried along by the 1st Element that surrounds them, do agitate more strongly than the *first* alone can. Wherefore, if the force of these parts that are hurried away by the *first* be so great, that they be able to push far from them all the parts of the *second*, which the neighbouring *Air* is full of, and keep them so; then the *Flame* appears, as we see in *Wax*, *Grease*, *Oyl*, *Brimstone* and *Gunpowder* set on *Fire*: But if they be not of force enough to do this, then the *Fire* lies overwhelm'd with much *Ashes*, as in *Leaves*, *Touchwood*, or any other dry *Fewel*.

Fire is also generated by concentrating the *Rays* of the *Sun*.

The Reason is, because *Light* is nothing else but the motion of the 2^d Element, produced by the 1st, whereby the 3^d Element is made visible. For it may happen, that upon the uniting of several *Rays*, some part of the 3^d, may be separated from its other like parts, and from the 2^d, and consequently be surrounded only with the 1st, whose motion it must then follow. Thus in our time *Burning-glasses* have been invented, by which *Metals* may be *Melted*, and *Wood* suddainly set on *Fire*.

Some kinds of *Fire* do shine, and yet are destitute of all heat. For they who use the *Sea*, observe that at sometimes when *Waves* are dasht against *Rocks*, they appear as if flames of *Fire* rebounded from them. And thus also *Rays* of *Light* proceed from *Rotten-wood*, and *Saltsfish*, but without any sensible heat.

The Reason is, because the Matter of the 1st Element, which is shut up in the *Pores* of such *Bodies* as these, tho' they be of force enough to push the *Globuli* of the 2^d Element, and to move the *Retina*, as much as is sufficient to produce the perception of *Light*; yet is too weak, to separate the

XIV.
What is the Reason of the great Tides that are in the River Seine about the Equinoxes and Solstices.

XV.
Whether the River Euripus Ebb and Flow so many times a day, as some antient Historians have left upon Record.

XVI.
Why there is no Tide in Rivers and Lakes.

XVII.
Nor any Tide in the Dead Sea, nor in the Euxine Sea.

I.
How Fire produceth or propagates Fire.

II.
How Fire is generated by concentration of the Beams of the Sun.

III.
There be some Fires that shine without heat.

the *Earthly parts* from one another, and to excite that agitation in them, which is strong enough to produce *heat*. *Fire* therefore only *shines*, when the *Pores* of the *Terrestrial Particles* are so narrow, that they can only admit the first *Element*, and shut out every thick *Body*. Thus when the pointed *Needles*, as it were, of *Salt* do enter the *strait Pores* of *Fishes*, and drive thence the *Globuli* of the 2d *Element*, so as to be open only for the admission of the matter of the 1st *Element*, they by this means make the *Fishes Scales* to shine like *Glow-worms*. *Historians* tell us of a certain *Fly* in *New Spain*, of the bigness of a *Beetle*, called *Cocujus*, whose *Eyes* do enlighten the *Night* like a *Wax Candle*, so that it serves for a *Lantern* to those that walk by *Night*, and for a *Lamp* to burn in ones *Chamber*; and by the *Light* whereof one may read or write; and have the same effect when the *Insect* is dead, as when yet alive.

IV.
Some Fires
burn with-
out giving
Light.

Some *Bodies* afford great *Heat*, but are destitute of all manner of *Light*: As the *Blood* of *Live Animals*, *Horsdung* tending to putrefaction, *Quick-Lime* sprinkled with *water*, in which things there is a hidden *Fire* that burns and scorseth, without the appearance of any *Flame*.

The Reason is, because in such *Bodies* as these, the parts that surround the 1st *Element*, and that are agitated by it, are too soft and limber to transmit the *Action* of *Light*. For tho' some of them swim on the top of the matter of the 1st *Element*; and comply with its motions; yet because some *Watry* and *Aiery* plyable parts, are mingled with them, they have the power to kindle *heat* and *fire*, but not of receiving the action of *Light*. Hence it is that when the *Spirit* of *Vitriol* and *Oyl* of *Tartar* are poured together, an effervescence or boiling is caused, because the free passage of the subtil matter being hindered in them, doth produce a wrestling or contest betwixt these 2 *Liquors*, which is the cause of a vehement *heat*. And for this Reason *Horsdung*, and the *Blood* of *Live Animals* are hot, because the 1st *Element* is pent up by a softer matter, within the narrow pores of the parts. And therefore they are only hot, that is, they have only the force to move those *Nerves* that are subservient to the *Touch*, but not of pushing the *Celestial Globuli*, wherein the nature of *Light* doth consist. *Quick-Lime* sprinkled with *water*, waxeth hot, because its parts are so suited and disposed, as to admit the *water* surrounded only with the matter of the 1st *Element*; so that the *Globuli*, being expelled, the matter of the 1st *Element* only bears sway. For those *Bodies* are said to have the form of *Fire*, whose particles do separately comply with the motion of the 1st *Element*, and imitate the agitation thereof.

V.
Why the
Flame
mounts up-
wards.

Flame, by a natural propensity, mounts upwards towards *Heaven*; and to the end it may the sooner get thither, it quits its thickness, and takes to it self a *Conical Figure*.

It may be said that the *Flame* doth not so much affect to mount upwards, as it is by outward force driven up thither; for being on all sides surrounded by the *Air*, and by reason of its less degree of agitation, as it were, continually beaten by it, it rather tends upwards than downwards, because it meets with less resistance there. The way this is performed take as follows. The matter of the 1st *Element*, which is predominant

in the *Flame*, being in perpetual motion, strives continually to depart from the place where it is; and being lighter than the *Globuli* of the 2d *Element*, it is carried upwards, and withdraws it self from the *Center* of the *Earth*; and forasmuch as no *Body* can be moved, except some other, by a circular motion, enter into its place, as much *Air* returns towards the *Flame*, as there is *Smoak* that goes from it; and therefore the *Air*, which, as it were, licks the upper part of the *Candle*, mixing it self with the parts of the *Wax* or *Tallow*, affords fuel to the *Flame*: So that the power of dilating the *Fire*, and driving it upwards, may in some sort be attributed to the *Air*. Now the reason why the *Flame* is of a *Conical Figure*, and ends in a sharp point, is evident, because the middlemost parts of the *Flame* have more agitation, and consequently move with more force, and are sooner carried upwards, than the outward parts, whose agitation is diminished by the nearness and contact of the *Air*.

From what hath been said, it is evident, that a *Pyramidal Figure* is accidental to *fire*, because the *Air*, by compressing the parts of the *Flame*, doth form it into that figure. For if we take a *Wax-Candle*, and place it in an *Iron Pipe*, and put the said *Pipe* into a *Porringer* full of *Spirit* of *Wine*, and afterwards set the *Wax-Candle* and *Spirit* of *Wine* upon the *fire*, we shall find that the flame of the *Wax-Candle* will be dilated, and swell 4 or 5 times greater than it was, and will then appear of a *round*, and not of a *Pyramidal Figure*.

In the *Winter*, when the *Air* is most compressed and condensed with *Cold*, the *Fire* burns most fiercely; and in *Rainy Weather*, and more especially when the *Sun* shines upon the *hearth* more weakly.

The Reason is, because *Sulphureous Particles* are necessary for the preservation of the *Fire*, which do break forth from the combustible matter; and *Nitrous* also, which are mingled with our *Air*: Now seeing that the *Air* in *Winter*, doth most of all abound with these *Nitrous Corpuscles*, it cannot be otherwise, but that the greater quantity of these must make the *Fire* burn more fiercely. Whereas, when the *Sun* shines upon the *Hearth*, the *Nitrous Particles* in the *Air* are scattered, and consequently the force of the *Fire* debilitated and almost extinguish'd. Hence it is that when a *Lamp* or other *Light* is put into a large *Glass*, fit for that purpose, as soon as the *Air* is pumped out, it is presently extinguish'd; not so much because it is choaked by its own *Smoak*, as because it wants this *Nitrous Aliment* contained in the *Air*.

A *Candle* that burns with a long *Wick*, smoaks more than another that is new snuff.

The Reason is, because in a longer *Wick*, the thicker parts of the *Candle* being mingled with the *sulphureous*, are without any loss carried upwards. But in a snuff *Candle*, that more fat and *sulphureous* matter which constitutes the *Smoak*, by being much agitated in the *Flame*, is reduced into most minute parts, as may be easily gathered from the crackling noise they make. This is the reason also, why a *Plate* of *Iron*, or other *Metal* being approach'd to the utmost parts of the *Flame*, contracts only some little smuttiness, because the *Terrestrial Matter* is by the force of the *heat* reduc'd to so small parts, that they are no longer perceptible

VI.
A Pyrami-
dal Figure
is accident-
al to
Flame.

VII.
The Fire
burns more
fiercely in
the Winter
than in the
Summer.

VIII.
Why a Can-
dle with a
long Wick,
smoaks
more than
that with
a short one.

ble in their egress from the *Flame*, nor adhere to any *Body*: But when this *Plate* is thrust into the midst of the *Flame*, it is covered all over with *Smut* and *Soot*; and that by means of those grosser particles, that are not thoroughly subdu'd by the heat of the *Flame*.

IX. But if a *Cotten Wick* be laid to steep 24 hours in *Whitewine Vinegar*, impregnated with half its quantity of pure *Nitre*, and afterwards expos'd to the *Sun* to be dried, it will not send forth any *Smoak*, because the *saline* and *volatil parts* of the *Nitre* and *Vinegar*, do so divide and agitate all the *moisture*, that no part of it can escape the force of the *Flame*.

X. *Spirit of Vitriol* and *Oyl of Tartar* pour'd together, produce an *Ebullition*, or *Effervescence*.

The Reason is, because the *pores* of one of these *liquors* are so formed, that they can only admit the *branchy parts* of the other *liquor*, wrapt about with the *matter* of the first *Element*; by which means the first *Element* having repulst the *Globuli* of the 2d, does alone bear sway. Or because the *subtil matter*, being wont to flow and move otherwise in the *Spirit of Vitriol*, than in the *Oyl of Tartar*, when its free passage is stop't, it causeth a kind of contest between the 2 *liquors*, and an effervescence or ebullition by reason of the mutual agitation of their parts.

XI. *Fire* is commonly kindled by a *Blast*, whether of a *Bellows*, or otherwise.

Because by this means the *Ashes* which cover the surface of the *Coals*, and obstruct their more open pores, is driven away; by which means the *Fire* that was about to break forth, is driven inward, and there so separates and divides the parts of the *Coals*, and thoroughly penetrates them, as to invade and kindle the fat and inflammable particles also. And hence it is that the *flame*, when blown upon, makes a noise, which is caused by the resistance of its parts, and the mutual combination that is between them.

XII. *Fire* is quenched, when its parts are scattered and dispers'd, as it is kindled by the uniting of them. Thus we find, that either too fierce and violent a *Blast* of *Wind*, or a copious affusion of *Water*, doth dissipate the particles of *Fire*: The same effect is also caused by a steam that is shut up, and hath no vent to get out by; for then the said *Vapour* being beat back, and rebounding upon it self, doth divide the parts of *Fire*. And by this means it is that a *Candle* is often put out in a *VVine Cellar*, filled with the steams of *New VVine*.

XIII. The *Smoak* that proceeds from *Wood*, makes the *Eyes* smart, and produceth *Tears*.

The Cause thereof are the sharp and biting particles whereof the *Smoak* consists; which, twitching the surface of the *Eye*, and contracting the same, cannot but cause *Tears* to break forth. Forasmuch, as by this contraction, the *Kernels* in the Corners of the *Eyes* are squeezed, and consequently let out the humour contained in them. *Onions* produce the same effect, when they are cut, or otherwise divided into *Parts*; at which time a sharp vapour or steam proceeds from them; which reaching the *Eye*, provokes *Tears*. And probably it is for the same reason, that some *Fumes* are of use to still the *Toothach*, whilst by their sharp particles they do open the pores of the *Gums*, and not only make way for the Pain-causing Humour

to pass away, but also excite it to evacuation. Thus a *Fumigation* is made with the *Bran* of *Wheat*, mixt with fine *Sugar*, which is found to be of use for this purpose.

Some sorts of *Fire*, by Authors called *Greek-fires*, cannot be quench'd with *water*.

These *Fires* derive this effect from the solidity of their parts, and the swiftness of their *Agitation*, whereby they beat back the parts of the *water*. For one of the chiefest things required to the preservation of *Fire*, is this, that it have a sufficient quantity of *earthly particles*, which being driven and agitated by the first *Element*, have the power to hinder the choaking of it by the *Air*, or other *Liquors* pour'd upon it. Which force doth most of all abound in *Bituminous*, *Oily* and *Sulphureous Substances*, whereof these *Greek-fires* are composed. Forasmuch as these, by reason of their *Thickness*, and the sticking together of their *Branchy Parts*, are most proper to keep their station, and so to move the *water*, as to beat back the *Ethereal Globuli*, which by their irruption might extinguish the *Fire*.

The contrary hereunto happens in *Vaults* and *Wine-cellars*, especially when the *New Wine* is working in the *Vessels*; for then not only the *Candles* that are brought lighted into the *Cellar*, are extinguish'd, but even *Torches* also; because their flames being fill'd with the steams of the *New Wine*, do not consist of any such matter as is able to repress and put by the *Air* that hangs over them; nor are they strong enough to force it to enter into it self.

Fire is struck out of a *Flint*, with a *Steel*; yea one piece of *Steel* rub'd against another, doth produce *fire*. There are also some *Stones*, that are called *Live-stones*, that being struck with a *Nail*, or hit with another *Stone*, do send forth *Sparks*. And in like manner the *Indians* also procure *fire* by joining 2 *Sticks* together, and then take a 3d, which they very swiftly twirl about between them, till they be set on *fire*.

The cause of this production of *Fire* is, because when the hard and brittle parts of the *Flint*, and the other mentioned *Bodies*, are hit against by a hard *Body*, many of the spaces, which lie between their particles, and which were wont to be filled with the *Globuli* of the 2d *Element*, are made more narrow than they were before; and therefore as soon as the *Heavenly Globuli* are driven away by the force of the said *stroak*, nothing remains besides the most subtil matter, for to receive these thick particles, and to turn them round very swiftly. And therefore, forasmuch as the parts of *Flint* are very stiff, and apt to fly into shivers, they do indeed give way to the force of the *stroak*, but immediately rebound again; and thereupon being separated from each other, and hurried away by the motion of the first *Element*, they turn to *Sparks*, and constitute the form of *fire*. And thus in like manner is *fire* kindled by the vehement rubbing of *Sticks* against one another; because by this continued violent motion, their particles are first drawn together, and afterwards being with great force separated from one another, whirl round; by which means, not only the parts of the *Air*, but also the *Ethereal Globuli*, that surround them, are separated from each other; and being whirl'd round by the vehement agitation of the first Ele-

XIV. *Greek fires*, so called, cannot be quenched with *water*.

XV. *Why Fire is easily quenched in Wine-Cellars.*

XVI. *How Fire is to be struck out of Flint, Steel, Stones, and some sorts of Wood.*

ment, turn to sparks, and exhibit the appearance of fire. Thus the *Apulians* wind *Cords* about a Stick; and by swiftly twitching them this way and that way, do set them on fire.

XVII.
Why Hay,
when it is
shut up
close, grows
hot.

When *Hay* is laid up before it is thorow dry, it grows *hot*, and *burns*; which never happens when it is spread in a large and open field.

The Reason is, because *Hay*, whilst it is yet New, doth abound with many *Spirits*, and several *Juices*; which being accustomed to move thorow the *pores* of the *Green Herbs* from their *Roots*, to their upper parts, do still continue in them for some time after that they are cut down. Which as soon as they are shut up in a close place, the *particles* of these *Juices*, passing from one *Herb* into another, do find the *pores* of them more narrow than they were, by reason of the contraction of their *Fibres*, so that they cannot enter them, without leaving the *Globuli* of the 2d Element behind them; and being only surrounded with the *particles* of the first, and so complying with their most rapid motion, are of sufficient force to agitate and heat the thicker parts of the *Hay*. As for Example, if the Interval, which lies between the 2 Bodies B and C, be supposed to represent one of the *Pores* of a green *Herb*, and the small strings 1, 2, 3, surrounded with little round *Bodies*, exhibit the pieces carried by the matter of the 2d Element; and the Interval D and E, another narrow pore of an *Herb*, that is in part dried, through which the forefaid particles 1, 2, 3, pass, no longer swimming on the 2d Element, but on the 1st only: It is evident, that those that are between B and C, must follow the temperate agitation of the 2d Element; whereas those betwixt D and E, will be forced to comply with the most swift agitation of the 1st Element. I said, In case the *Hay*, before it is fully dry, be laid up in some narrow or close place; because as long as it is exposed in any open place, the *juice* which runs through the *pores* of the *Herbs*, is easily dissipated in the *Air*, without passing through the *pores* of the other strings, wherein it might excite a *heat*, and cause a *Conflagration*.

Figure
19.

XVIII.
What the
reason is
why Gun-
powder is
so easily
kindled.

Nothing is more easily kindled than *Gunpowder*.

The Reason is, because it is compounded of *Brimstone*, *Nitre* and *Charcoal*, which of all things do most easily take fire: For *Brimstone*, we know, flames immediately, because it consists of *particles* of sharp *juices*, which are wrapt about with the thin and close branchy *particles* of an Oily Matter, so as that many *pores* between the said *Branches*, can only admit the matter of the first Element. But *Nitre* consists of longish and stiff *Particles*, which being agitated by the *particles* of *Brimstone*, do diffuse themselves into a larger space. And seeing that the *Charcoal* also doth abound with many *Pores*, the *Brimstone* and *Nitre* do readily enter the same, and by them are straitned. By which means it happens, that as soon as any fire toucheth a grain of *Powder*, composed of these materials, it presently enters the same through the *pores* of the *Coals*, and presently agitates the parts of the *Brimstone*, which afterwards move those of the *Nitre* and *Charcoal*.

XIX.
Some
Lamps
have been

Authors tell us of *Lamps*, that of old times were used to be put into the *Sepulchers* of the *Dead*, and continued burning many ages, without any

diminution of their *Light*. LUDOVICUS VIVES in his notes upon the XXI Book of *St. Austin de Civitate Dei*, tells us, That upon the breaking open of a certain *Grave*, a *Lamp* was found that had burnt 1500 years, but that as soon as it was touched with the hand it mouldred into the smallest *Albes*. FORTUNIVS LICETUS also informs us, that about 100 years since, in the *Papacy* of *Paul III*, a *Lamp* was found in the *Sepulcher* of *TULLIA*, *Cicero's* Daughter, but upon the admission of the *Air*, and *Light*, was presently extinguish'd.

GASSENDUS reckons these *Lamps* amongst those *Ludicrous Lights*, which burn when the *Air* is shut out, and vanish as soon as it is admitted; when according to him, they ought to be rather kindled a-new upon the letting in of the *Air*, and so burn the stronger. But as for my part I see no reason why a fire or flame may not be preserved in *subterraneous places*, where it cannot be impaired or disturbed by the blowing of the *Wind*, or the distemperature of the *Air*. For it may so happen, that the *particles* of the *Soot*, which proceed from the *Candle* or *Lamp*, may close together about the *Flame* of the *Lamp*, and so constitute a kind of little *Vault* or *Arch* about it, by which the *Air* may be kept off from rushing upon the *flame*, and so overwhelm and choak it. For such an *Arch* as this would be of use to infringe the force of the *flame* from kindling the further parts of the *Oyl* or *Wick*. So that by this means the 1st Element in such a *Lamp*, being wrapt up round like a *Star*, would repel the *Aerereal Globuli* that are round about it, and so diffuse its *Light* throughout the whole *Sepulcher*; which tho' but weak and dusky, yet upon breaking in of the *Air*, and the dispelling of the *Soot*, which did encompass it, doth discover a bright and shining *Lamp*.

The *Flame* of *Spirit of Wine* doth not consume a Rag of *Linnen*.

The Reason is, because that to the end a *Body* may be fit to feed the fire, it must have many *particles* fit and suited to the fire which it is to preserve, and the same so joined to one another, or to other thicker than themselves, that by the driving or impulse of the *particles* of the said fire, they may be separated as well from themselves, as from the adjoining *Globuli* of the 2d Element, and by this means take upon them the form of fire: Whereas the *particles* of the *Linnen Rag* are not thin enough to be agitated by the *flame* of the *Spirit of Wine*, and to be separated from one another.

For every fire is by so much the more strong and vehement, the more fat and tenacious the matter is that feeds it. Again, amongst fat *Bodies*, some are much more apt to kindle than others. For *Spirit of Wine*, the purer it is, and the more highly rectified, the more inflammable it is also, because it hath little or no *Phlegm* remaining with it. Thus that kind of *Stone* which is burnt into *Quick-Lime*, cannot without great difficulty take fire, because its parts being very closely joined together, the fatness that is contained in them, cannot easily be disentangled or driven out from them, to the end it may be kindled into a flame.

When

found that
have burnt
many years
in Sepul-
chers.

XX.
A Flame
proceeding
from Spirit
of Wine,
doth not
burn a Lin-
nen Rag,
but only the
Spirit of
Wine it
self.

XXI.
All fat
things are
not kindled
after one
and the
same man-
ner.





XXII.
What the
Reason is,
that Sparks
of Fire
sometimes
appear
upon
strongly
Rubbing a
Cats Back.

When a *Cats* Back is strongly rubb'd with ones hand, Sparks of *Fire* seem to proceed from it.

The Reason whereof seems to be this, because this Rubbing drives out some *Particles* of *Moisture*, and 'causeth them to be dissipated into the *Air*; whereupon the *particles* of the *fire*, or if you will, the *Sulphureous*, *greasy Particles*, wherewith the *Hair* and *Skins* of *Animals* do abound, and those of *Cats* more than any other, croud and meet together, whence proceeds *fire*, and from the *fire*, *light*. Now this *fiery Steam*, or *Exhalation*, is easily retain'd or kept close in this *Thicket of Hair*, which consisting wholly of *Sulphureous filaments*, becomes easily entangled amongst the said *Hairs*. Which is the true Reason, why a *Garment* lin'd with *Fur* doth so obstinately retain the *heat* committed to it, and keep off the *Cold*. But it is to be noted, that these *sparks* of *Light*, which by stroaking are forc'd from the *Back* of a *Cat*, do only appear in the *Dark*, because a greater *Light* obscures and swallows them, as the *Light* of the *Sun* does that of the *Stars*.

CHAP. VIII.

Of Earthquakes, and Subterraneous Fires.

I.
The Cause
of Earth-
quakes.

THE Country of *Campagna di Roma*, in *Italy*, Trembled for many days, by an *Earthquake* in the beginning of the year, when *L. CORNELIUS* and *Q. MINUTIUS* were *Consuls*, and that with such frequent and reiterated *Concussions*, that, as *LIVY* acquaints us, the *People* were not only tired and afflicted with the frequent returns of the *Earthquake*, but also by reason of the *Holy-days* that were appointed upon that account, to deprecate the *Wrath of Heaven*.

Some do impute the Cause of *Earthquakes* to the *Sun*, as supposing that by his *heat*, he doth attract those *Exhalations* out of the *Caverns* and *Holes* of the *Earth*, to the *surface* of it. But Reason assures us that this cannot be, because the *Sun's Rays* cannot penetrate so great a *Depth* of *Earth*: For tho' the *Earthy particles*, being beat upon by the *Rays* of the *Sun*, do agitate others which are near to them, and to which the *Rays* themselves cannot reach; and these again, others that lye near to them, and so on; yet is not this *Commotion* of the *parts* of the *Earth* sufficient to kindle a *fire* in it. Wherefore it seems more Rational for us to attribute the Cause of these *Earthquakes* to those *Exhalations*, which mounting through the *Chinks* and *Cavities* of the *Earth*, do there compose fat and thick *Fumes*, not much unlike to those which proceed from a *Candle* newly extinguish'd, and fill the whole space that is about it, which by a *spark* of *Fire*, either from *Flints* hitting against each other, or by some *Candle* that *Miners* make use of in their labour, are presently kindled; and being thereby vastly rarefied, shatter to pieces all the confinements of their too narrow *Prisons*, and force all the *Bodies* that stand in their way.

Thus *AGRICOLA* tells us, that in the Country of *Misnia* in *Germany*, there is a *Mountain* of *Smiths-Coals* that burns continually; where, according as the *Flames* spread and consume the *Coals*, the *Earth* sinks down and leaves deep *Holes*, which appear like so many burning *Furnaces*; the *flame* whereof sets any fit *Matter* on *fire*, that is at 4 Foot distance from them. In like manner, in the *Island Del Moro*, the *Fire* bursts forth with such extream *Noise*, that it equals the *Thundering* of the greatest *Cannon*, and with so thick a *Smoak*, that it may be compared with *Midnight-Darkness*; and with such a prodigious quantity of *Ashes* and *Cinders*, that *Houses* are crush'd under the weight of it, *Cattle* and other *Beasts* destroyed, and *Fresh-waters* turned into *bitter*.

Now whenever the *Exhalations* that are kindled in these *Caverns*, are not of force enough to break their way through the *surface* of the *Earth*, they only produce a *shaking* or *trembling*, that is, they only cause the *Earth* that is above them to rise: In like manner as *Gunpowder* heaves up the *Ground* under which the *Mines* are laid: And the said *Exhalations* appear outwardly, when they have strength enough to open the *ground*.

In *Earthquakes*, there are many times repeated *shakings* succeeding one another.

The Reason of this is, because the *Matter* that is kindled, is not always altogether in one and the same *Cavity*; but in many, which are only separated by a little *sulphureous Earth*: And therefore when the *Fire* takes in one of these *Cavities*, it gives the first shake to the *Earth*, and a second, when it kindles that which is in the next, after having consumed the *sulphureous Matter* that did separate them, and so on to the very last *Cavity*.

Some parts only of the *Earth* are shaken in *Earthquakes*, not the whole *Ball* thereof.

The Reason is evident, for that the *Exhalations* which abound in the *Earth*, and which have the power of *shaking* it, do not every where meet with a space wherein to dilate themselves. For since there are innumerable *subterranean Cavities*, and various *hollows* and *windings*, ready to admit any foreign *Bodies*, we cannot well conceive them to be all fill'd with the same *Matter*. For some of them contain *Waters*, which because of their innate *Coldness*, and the thicknes and feculency of their *parts*, do stagnate without any *motion*. Others are full of a thick and foggy *Air*, which being pent up within narrow *Walls*, is never driven out of its *Holes* without some force. Others again are taken up by *fire*, or rather *fiery Steams* and *Exhalations*; but such as are shut up in their *Dungeons*, and being unable to break forth, lye very quiet there without doing any mischief. Now these *Steams* or *Exhalations*, pent up within the *Bowels* of the *Earth*, from the various coalition whereof, *Brimstone*, *Jews-lime*, and other such like *inflamable Bodies* are made, like a *smoking Torch*, are kindled either by another *Fire*, or by the striking of *hard Bodies* against one another, or by the mixture of *Liquors* proper to produce an effervescence, and a consequent *flame*; and by means whereof being now more dilated, they push against the sides of their *Dungeons* and shake the *Earth*, till at last having broke through

II.
Misnia in
Germany,
and the
Island del
Moro, have
subterra-
neous Fires
that burn
in the
Bowels of
them.

III.
Why in
some Earth-
quakes
there be
several
successive
shakings.

IV.
An Earth-
quake
never
assaults the
whole
Earth, but
only some
particular
parts of it.

V.
What
places
are most
subject to
Earth-
quakes.

through their *Prison-walls*, they burst forth, and rush to take possession of a free and open *Career*. And forasmuch as these *Exhalations* are very inconsiderable, and bear no proportion to the whole *Globe* of the *Earth*, they can only shake some parts of it, without concerning the whole.

Sea-Coasts of all other places are most subject to *Earthquakes*, because much fat and slimy Matter flows from the *Sea*, into the several *subterraneous Cavities*, which are very proper to feed the *Fire*. And therefore we find that *Earthquakes* very seldom are heard of in the *Northern* parts of the *World*, especially those that are remote from the *Sea*; because they have not Matter enough to produce these *Concussions*, the same being either drawn off by the heat of the *Sun*, or else because it is but gradually and in small quantities conveyed from the *Sea*. To which we may add, that in the *Parts* now mention'd, there are but few *subterranean Caverns* to admit this Matter: For this looseness of the *Earth*, and the wide and open *Cavities* contain'd in the *Bowels* of it, do much conduce towards the causing of these *Earthquakes*; because fresh Matter is laid up in store in them, for the producing of these Effects.

VI.
When and
where
Earth-
quakes
are most
frequent.

Accordingly we find, that *Earthquakes* are most frequent in those places where the *Earth* abounds with *Caverns* and *subterraneous Cavities*, which are the proper and fit receptacle for those *Exhalations*; except the said *Cavities* be open towards *Heaven*, and so afford a free passage for the *Exhalations* to fly away. Wherefore also *Earthquakes* chiefly happen, when abundance of such *Exhalations* are found in the *Earth*; as in the *Spring* and *Autumn*.

VII.
What is
the Cause
of the
great Noise
that is
consequent
upon Earth-
quakes.

Every *Earthquake* is followed by a Noise, not much unlike that of *Thunder*, which always accompanies, and sometimes goes before it.

The Reason hereof is, because the *Fire* which is rarefied within the *Cavities* of the *Earth*, doth rebound and return upon it self: For seeing that in these *Caverns* there be innumerable winding Passages, which the kindled *Exhalations* go through, it cannot be but that the sound must needs be multiplied in its passage through them. Thus we know that *Eccho's* are most frequent in *Caves* and *Hollow places*: And thus we find, that from certain crooked *Horns*, which the *Musicians* from their windings call *Serpents*, a kind of Lowing Noise doth proceed, which is only to be attributed to those windings and turnings by which the said sound is conveyed to our *Ears*. Every *Earthquake* therefore is accompanied either with a greater or less Noise, according as the matter is more swiftly or more slowly kindled, and as the rarefied *Exhalations*, do break forth with greater or weaker force, and display themselves by many or fewer *Concussions*.

VIII.
Whence
that great
Fire that
proceeds
from *Etna*
and *Vesuvius*,
is
caused.

The *Earth* in many places casts forth *Fire* through the top of many *Mountains*: Thus Mount *Etna* in *Sicily*, *Vesuvius* in *Naples*, *Hecla* in *Iseland*, &c. do disgorge *Flames*, and cover the Neighbouring *Countries* with *Ashes*. The Mountain *Vesuvius*, now called *Monte di Soma*, according to the Relation of *DION CASSIUS* did burn in the year that *TITUS VESPASIANUS* and *FLAVIUS DOMITIANUS* were the 7th time *Consuls*, and breaking forth at the top, at first cast forth

Stones, and afterwards such a vast quantity of *Flames*, that 2 Towns, *Herculaneum* and *Pompeium* were thereby consumed; such thick *Smoak*, that they darkened the Light of the *Sun*, and last of all pour'd forth such a storm of thick *Ashes*, that it cover'd all the Neighbouring Country like a high *Snow*, and which by the force of the *Wind* was carried over into *Africa*.

There is no question to be made, but that *Fire* is generated in the *Earth*, seeing that a vast quantity of *Brimstone* and *Jewels-lime* is contained in the same, which are of a very Fat substance above all others, and are most readily kindled: Neither do we find any matter within the *Bowels* of the *Earth*, is better suited for the production of *Fire*; and therefore we may well conclude, that whatsoever burns, or is hot, is preserved and maintained by the mixture of both these. And therefore no *Fire* breaks forth any where, neither doth any heat manifest it self, where both of these, or at least the one of them doth not bear sway. The *Wind* also may contribute not a little to the increase and dilatation of the *Fire* that lies hid in the *Caverns* of the *Earth*, whilst by entering into them, it doth more or less blow them up and kindle them, and makes the flame more violent.

When *Fires* first began to break forth from this Mountain, doth not appear from History: *VIRGIL* tells us, that in *ÆNEAS* his time, when in his Voyage to *Italy* he put in at *Sicily*, Mount *Etna* poured forth *Smoak* and *Cinders*, with a horrid roaring Noise. And *THUCYDIDES* acquaints us, that this Mountain burnt in the 76th *Olympiad*, that is, 476 years before the Birth of *Christ*. And several times after that, as in the time of *CALIGULA*, &c.

In the Year 1580, a Mountain in the Isle of *Java*, not far from the City *Panacura*, began to burn, the top of it being burst open with a violent eruption of *Brimstone*, so that 10000 Persons were consumed in the Country thereabouts, and cast forth vast great *Stones* upon the City *Panacura*. Moreover, for 3 days together it sent forth so much thick *Smoak*, mixt with *Flames* and *Cinders*, that it did cover the *Sun*, and almost turned the *Day* into *Night*.

There are found some other Mountains, that now burn no longer. Thus in the Island *Quimoda*, not far from the Mouth of the River *Rio de la Plata*, there is a Mountain that burnt formerly, but hath now ceased. So likewise there are several Mountains in *Congo* and *Angola*, as also in the *Azores*, especially those of *Tercera* and *St. Michael*, which formerly cast forth flames, whereas now nothing but *smoak* proceeds from them; and this, because the *Sulphurous* and *Bituminous* matter, which is the most proper to kindle and feed *Fire*, is quite consumed in them.

The Reason why these *Subterranean flames*, do generally get up to the tops of Mountains, and thence make their terrible Eruptions, is to be taken from the Nature of *Fire*, which being pent up in these *Cavities*, and not being able to dilate and spread it self, makes a breach in the *Walls* of its *Prison* upwards, rather than elsewhere, because there it finds less resistance, and being once broke forth, it continues burning as long as the fuel lasts.

The

IX.
When
Etna first
began to
burn.

X.
When the
Mountain
in the Isle
of *Java*
began to
burn.

XI.
Of some
Mountains
that burnt
formerly,
and have
now ceased.

XII.
Why these
subterra-
neous Fires
do com-
monly
break
forth at
the Tops of
Mountains.

XIII.
Why the
Fire doth
not break
forth from
lower
Grounds,
as well
as from
Mountains.

Subterraneous Fires seldom break forth from lower grounds; but very frequently from the Bowels of *Mountains*.

Of this, a twofold Reason may be given; First, Because *Mountains* contain many *Cavities*: And, 2dly, because those great fragments, whereof the outward Crust of the *Earth* doth consist, and which are so posited as to lean upon one another, do afford a more easie Egress to the flame, than the other parts. And tho' these Openings of the *Earth*, do close again, as soon as the flame is broke forth from them; yet there may be so great a quantity of *Brimstone*, and *Bitumen* or *Jews-lime* carried up from the Bowels towards the top of the *Mountain*, as may furnish sufficient Matter for a long continued burning. And as for those Steams which are afterwards gather'd again in these *Cavities*, and kindled, they easily afterwards make their way by the passage that is already open'd for them.

XIV.
Why these
Flames
break forth
from
Mountains
only at
certain
times and
seasons.

Burning Mountains, after some time cease to cast forth Flame and *Smoak*, and after this Cessation return to the same task again.

The Reason is, because that when the Sides of these *Mountains* are burst open, *Water* comes flowing in to the said *Cavities*, and stops up the Passages to them, so as that the Matter of *Exhalations* cannot so quickly be gather'd there again, and afford Matter to succeeding flames. It also very frequently happens, that by means of this vehement eruption of flames, the parts of the *Mountain* are overthrown, and fall down into the bottom of the Deep, from whence the fire did proceed; and the way for the *Exhalations* to break forth at, being thus stop'd up, no further Burnings can be expected, till a fresh quantity of *Brimstone* and *Jews-lime* be gathered and kindled, which by its breaking forth may open those stop'd Passages again, by casting up that which obstructed them. And this is the Reason why these *Fire-vomiting-Mountains* do not always retain the same Bigness: For *Vesuvius*, in Ancient Times, was of far greater bulk than now it is, and is scarcely an *Italian Mile* high, all its windings and turnings reckon'd in.

Nor will scorcht *Etna* ever vomit Flame,
Since from beginning't did not do the same.

Ovid. XV. *Metamorph.*

XV.
Why upon
an ap-
proaching
Earth-
quake
Well-
water be-
comes
troubled.

When an *Earthquake* is near, the *Water* of *Wells* becomes troubled and muddy, and sends forth a stinking smell.

This Effect is produced by the steam proceeding from the *Subterraneous fire*, which like a *smoak* breaking forth from a piece of *Wood* that is not thoroughly kindled, insinuates it self into the narrow pores of the *Earth*, and mingles it self with the said *Well-waters*. The said waters do likewise send forth a Noisom smell, because this steam, which ariseth from the Bowels of the *Earth*, proceeds from sulphureous and bituminous Bodies, wherewith the inward parts of the *Earth* do abound; which being of a strong and unpleasant smell, no wonder if their steams communicate a like odour to the waters.

CHAP. IX.

Of Ashes and Coals.

Ashes, or that light powder which remains after that the flame hath consumed all its fuel, in Combustible Bodies, are by Chymists compared unto Snow, and they commonly call it the Snow of the Earth.

Because, as Snow doth consist of most small Drops, which by means of a subtil Vapour are woven or entangled together into flocks; so in Ashes, the smallest particles of the Earth, by a subtil interweaving of filaments, are joyned together in lesser flocks, which may be discerned by the help of a Microscope.

Ashes soak up so much Water, that a Vessel fill'd with them doth very near contain as much Water, as another empty Vessel of the same bigness.

The Reason is, because the Pores that are intercepted between the parts of the Ashes, are like so many flocks, that take in the Liquor poured upon them. And they are perceived to have little Bodies, like to cast Skins that suck in the water, and hide the same within their thin surfaces. But yet we must not from hence conclude with the Peripateticks, that there is the same quantity of water in a Vessel fill'd with Ashes, as there is in an empty one, seeing that the Ashes can scarcely imbibe a 5th part.

Ashes are of great use for the scouring and washing clean of Bodies. And therefore those who take the spots of Oil, or any other greasy Matter out of Bodies, do make great use of Ashes, by means whereof they restore things to their former cleanness and neatness.

The Reason of this Effect is, because Bodies are made smooth by rubbing against one another, and lose all their Roughness: And therefore by the rubbing of Bodies with Ashes, all the dirt and the filth that sticks to them is wash'd away with help of Water, which is that Vehicle, whereby the Ashes are carried into the most intimate retreats of the Body, where the filth or stains do lurk; for having some part both of fatness and sharpness, they become entangled with them, and by rubbing fetch out whatsoever Unevenness remains in the Cloth. And thus by the mixture of Ashes and Water, a Lye is made, whilst the water being as it were strained through the pores of the Ashes, and taking along with it their sharpness and fatness, it is made very efficacious for the washing and cleansing of things, from those stains and spots that stick to them.

Hence it is observed, that the Ashes of Fig-trees have a peculiar virtue for the Cleansing of Bodies from filth and stains; because the leaves and wood, whereof they consist, do abound with fatness and sharpness, or acrimony, which entring into the inmost parts of Bodies, do carry the filth along with them. And it is for the same Reason, that these Ashes are found to be a good Remedy to stop the Fluxes of the Belly, and for the opening of Obstructions, making the Humors to run freely through the Body, and through the passages appointed for them.

I.
Why Ashes
are called
Snow.

II.
How it
comes to
pass, that
a Vessel
full of
Ashes, con-
tains al-
most as
much ma-
ter, as ano-
ther Vessel
of the
same big-
ness that is
Empty.

III.
Why Ashes
are of use
for the
cleansing
of Linen
and Wool-
len.

IV.
The Ashes
of Fig-
trees very
proper for
the washing
out of
Spots.

V.
Ashes pre-
serve the
Roots of
Plants
from the
cold.

The Roots of Plants in Winter are covered with Ashes, to preserve them from being damaged by the cold, and that the melted Snow or Ice running down to them, may not hurt or injure them.

The Reason of this common use is, because Ashes are dry, and almost destitute of all manner of Juice, and therefore drink up the melted Snow, and hide it within their Pores. For Ashes are hot, and are agitated with intestine motions. For as Vinegar and the Lees of Wine, do retain a warming Virtue; so Ashes are partakers of a Fiery quality, and are endued with a Virtue, that resists the effects of cold.

VI.
How Ashes
contribute
towards
the mak-
ing of the
Earth
fruitful.

And for the same Reason it is, that Ashes conduce to make the ground fruitful, because of the Salt that is in them. For the Fatness of the Earth is lodged in Salt and Nitre, which being resolved by moisture, and heated by the Sun, doth ferment, and yields new productions. And therefore those Ashes whence the Salt hath been extracted, are of no use for this purpose, which may be proved by this Experiment: Dig a quantity of Earth deep out of the Ground, and having divided it into 2 parts expose them to the Air, the one in the same Condition as it came out of the Ground, and the other wash several times by pouring water upon it, and suffering the same to run through it: And you shall find, that this latter will produce nothing, whereas the other will bring forth Herbs, Worms and little Pebbles within some short time after.

VII.
Why Coals
are of a
black co-
lour.

Coals and all other adust things, as Soot and such like are of a black colour.

The Reason is, because there are more Pores in Coals, and also in the burnt parts of Animals and Vegetables, than there were in the same Subjects before the Fire had touched them, and which may be seen in Charcoal, by means of a Microscope. Now this multiplicity of Pores swallows up the Light, and hinders it from being reflected to the Eye. And from the multiplicity and largeness of these Pores, remaining in stead of the grosser matter, that hath been turned into Smoak and Steam, the Lightness of Charcoal doth proceed.

VIII.
Why Coals
keep Fire
a great
while.

Coals do preserve Fire a good while, especially if they be covered with Ashes, and so kept from the Air coming to them.

The Reason is, because the Fire which lies hid in the Coals, is lodged in some thin and branchy Particles, which being intangled with others that are thicker, tho' they be most swiftly agitated, yet can only get out successively, that is, one after another. The Fire that is hid within the Pores of any Body, doth stand in need of some time, to have all its Particles dissolved, that by this means it may extricate it self from them; and probably before they can get thus free, the parts of the Coal must be worn and wasted by a long motion, and every one of them be subdivided into other parts again. But as long as the Air hath free access to Glowing Coals, they are much sooner consumed, because the Air doth by its motion blow away the Ashes, and entering into the Pores of the Coal, dilates them more than ordinary, and so makes way for the Fiery Particles to fly away.

IX.
How Wood
is turned

Thus a piece of Wood being put into a Vessel and covered with Sand, within a short time after that Fire hath been put under the said Vessel, the

Wood becomes turned into Charcoal, if so be the Vessel cover'd with Sand be not presently removed from the Fire, but so ordered that it may cool by degrees, nor too suddainly lose all its heat. For if as soon as the Vessel is taken from the Fire, the Sand be removed, the Wood upon the letting in of the Air, will presently begin to Flame, and be wholly resolved into Ashes. Because the Branchy Particles of the Wood, become by this means separated from each other, and upon the removing of that which hindered, are dissipated in the Air.

If a little water be sprinkled upon a live Coal, the heat is thereby encreased.

Because the moisture by entering into the Pores of the kindled Body, doth drive the Particles of the Fire into the inmost parts of it, and becomes mingled with them, but being forced to return by reason of the predominating heat, it carries the Particles of Fire, which lay hid in the Pores along with it, to the extrem parts of the Body. And the same is the reason, why water which extinguisheth small Fires, yet by the fatness which it contains doth make great Fires burn more fiercely, because by the motion of its flexible parts, it carries forth the heat, and raiseth the flame to a greater height.

In the making of Gunpowder, Charcoal-dust is mixed with Brimstone and Nitre, and being moistened with some Liquor, this Composition is formed into small Grains, which of all other matter do most readily kindle and take Fire.

The Reason why Charcoal-dust is made an ingredient of Gunpowder is, because it abounds with Pores, and therefore is most easily penetrable. And no wonder that Charcoal is very porous, seeing that before the Fire had wrought upon it, the wood it self had many little passages, which afterwards by the operation of the Fire, and the evaporation of so many Particles in Smoak and Steam, were much encreased: To which may be added, that Charcoal chiefly consists of 2 kind of parts, whereof the one are Thin and Branchy, which as soon as they come near the Fire are easily kindled; as having already been agitated by the force of the Fire, but yet continuing entangled together by their slender and manifold Branches, which also would have made their escape, if the quenching of the Fire, had not stop't their flight. The other parts contained in Charcoal are thicker, which if the Fire had acted longer upon them, would have been turned into Ashes. So that in this Composition of Gunpowder, the Branchy Particles of the Brimstone, and the sharp Needles of the Nitre, penetrating into the large Pores of the Charcoal, become entangled with its Branchy parts and closely drawn together, especially by that time they are dried, after that the whole mixture, by the addition of some moisture, hath been formed into small Grains. This composition becomes kindled in this manner; First, the Fire being applied, immediately kindles the Brimstone, and at the same time puts the Particles of Nitre into motion, which thereupon requiring a greater space wherein to take their turns, do rend the Bands of the Charcoal, and resolve the Grain into Flame and Smoak. For the resistance of the Charcoal doth greatly promote that swiftness, whereby the whirled Needles of the Nitre do break forth into a suddain Flame.

into Char-
coal, and
how into
Smoak and
Ashes.

X.
A Live
Coal being
sprinkled
with wa-
ter, grows
the better.

XI.
Why Char-
coal enters
the compo-
sition of
Gunpowder.

Ashes

XII.
Why *Ashes*
are white.

Ashes are commonly of a whitish colour, which grows much darker when *water* is cast upon them.

Ashes are white, because the *Particles* which constitute them, are *Spherical*; which our *Touch* can convince us of, forasmuch as they feel smooth without any roughness at all: And consequently reflecting the light on all sides, they exhibit a white colour; which becomes darker upon the affusion of *water*, because moisture, as has been said, promotes blackness.

XIII.
How *Wheat*
comes to
grow from
the *Ashes*
of it.

Credible *Authors* answer us, that *Wheat* hath sprung from the *Ashes* of it Sown in the Gound.

The Reason is, because the *Salt* which remains in the *Ashes* is a solid substance, and contains a great portion of *Earth*, and consequently is most proper for the generation of *Plants*, since it cannot easily be exhaled, and becomes resolved by the force of *Heat*. Wherefore these rudiments of the *Plants* remaining in the *Ashes*, being dissolved by some convenient moisture, and the warmth of the *Air*, spring forth into a new *Plant*. Thus *Hogs-dung* produceth *Sowthistles*, and that because it is common for these *Animals*, to feed upon them; for the *Seed* of *Sowthistles* remaining in the *Dung*, and resolved by beat and moisture, produce other *Plants* of the same nature.

XIV.
The *Ashes*
of a *Plant*
contain
the principles
of a
new *Plant*.

Hence it is that if we put the *Ashes* of any *Plant* into a *Vessel* with *water*, and expose the same to the *Air* in the *Winter-time*, as soon as the *water* is frozen, the resemblance of the *Plant* will be exprest on the *Ice*, at least the *Leaves* of it. Which is a pregnant Argument, that in the *Ashes* there remains a *Principle* of a new *Life*.

CHAP. X.

Of *Glasses*.

I.
What *Ashes*
are most
proper for
the making
of
Glasses.

THE most proper *Ashes* that are known, for the making of *Glasses*, are those of the *Herb Kali*, and *Fern*.

Tho' the parts of *Ashes* be very gross and irregular, and cannot, tho' they lean one upon another, so unite together, as to compose a hard *Body*, because the *Air* which fills the *Pores* that are left between them, doth hinder their Rest; yet the *Ashes* of the *Herb Kali* and *Fern*, are therefore the most proper of all others for the making of *Glasses*, because they abound with abundance of fixt *Salts*, which are very porous and spongy; so that when these *Ashes* are put into a violent *Fire*, their corners are consumed by it, and by this means the surface of their parts is made so smooth and even, that they touch in more Points than they did before, and afford a free passage to the *Beams* of *Light*, and cannot be rendred dark or opaque without the mixture of some *Forrein Matter*.

II.
Why *Glass*
is Transpa-
rent.

Glass notwithstanding that it is a hard *Body*, and made up of the thick and irregular *Particles* of *Ashes*, yet doth constitute Transparent and Light-some *Body*.

The cause of this perspicuity of *Glass*, may be easily gathered from the make of it. For whilst the matter of it, was by the violence of the *Fire* reduced to a liquid form, and all its *Particles* in agitation, the *Fire* flowing round about them, hollowed many *Cavities* in them, which the 2^d Element freely entering, diffused the action of *Light*

to all parts, in right Lines. And forasmuch as the said *Pores*, are after the *Glass* is made, continually preserved and kept open, by the incessant passage of the subtil matter, and are filled as before, they cannot but transmit the *Light* as formerly, so that the same transparency which was in the molten and liquid *Glass*, remains in the cold and hardned. For this is a thing common to all *Bodies* that are melted in the *Fire*, that whilst they are yet in that liquid form, their parts do easily accommodate themselves to any Figure, which they retain after that they are grown cold. If at any time any darkness be perceived in *Glass*, that proceeds from some *Dregs*, *Clouds* or *Bubbles* that are mingled in its texture, which since they are much more numerous in thick *Glass* than in thin, therefore we must impute the darkness of thick *Glasses* to them.

Glass is very Brittle, and will not suffer it self to be extended, but upon the least stroak breaks to shivers,

III.
Why *Glass*
is Brittle.

The Reason is, because tho' *Glass* be a hard *Body*, and does consist of parts that are thick enough, yet forasmuch as the surfaces by which they touch one another, are very small, so that they joyn only in Points, for this reason it is, that if they be never so little separated from each other, they lose their union and fly into bits. Whereas many soft *Bodies* are much harder to be broken, because they have their parts so intangled, that they cannot be separated, without the breaking of many of those *Branches*, by which they were held together.

It is a thing known by long experience, that *Glasses* after they have lasted a long time, do at last break of themselves. More particularly this is notorious to them, who grind those *Glasses* that are used in *Prospective Glasses*; for they find that after they have been polished a long time, they slit of themselves. The cause whereof is, because the *Saline Particles*, being agitated by the subtil Matter, do endeavour to break loose: As may be gathered from hence, that in the *Winter season*, and *Rainy weather*, something may be wiped from *Glasses*, that hath a *Saltish taste*. And not long since there was a certain man at *Amsterdam*, who broke *Rhenish-wine Glasses* only with his Voice, and that not very strong neither, but tuned to a certain Pitch.

IV.
Glass some-
times
breaks of
it self.

A *Glass* newly taken out of the *Furnace*, if it be exposed to the cold *Air* breaks immediately; and so likewise if any *water* be cast upon it.

The Reason is, because when the cold doth draw together and narrow the *Pores* of the *Glass*, the subtil Matter and the fiery *Particles* are by this means lockt up in them: And whilst the former of these press to make their way through the *Pores* of the *Glass*, and the others endeavour to get out from it, they by striving to widen the *Pores*, make the *Glass* to fly in pieces.

V.
Why *Glass*
that is
newly taken
out of the
Furnace
doth break
when ex-
posed to the
Air.

If a cold *Glass* be held so near to the *Fire*, that it heat in one part more than in another, it presently breaks.

The Reason is, because when the *Fire* is got in to the *Glass*, the *Pores* of it are not all equally dilated by it, and therefore when the subtil matter gets into them, seeing the *Pores* where the *Glass* is cold, are not wide enough for its free passage, it makes way for it self by rending the *Glass* to pieces.

VI.
A cold
Glass held
to near the
Fire cracks.

pieces. But if it be by degrees, and by little and little held to the fire, it will suffer no hurt at all; because all its pores will by this means be sufficiently dilated, so as to afford a free and open passage for the subtil matter. And therefore when Glasses that have contained any hot Liquor, are suddainly emptied and exposed to the Air, they crack immediately; because the subtil matter, which is pent up in the pores of Glass Vessels, striving to get out, finds no way for it self, because the pores are constringed by the coldness of the Air; and therefore makes its way by breaking the brittle sides of the Glasses.

VII.
How the
breaking of
Glasses may
be prevented.

To avoid this breaking of Glasses, they that belong to the Glass-houses, take the Glasses that are newly blown, and set them in a place at some distance from the fire to Neal, as they call it, removing them every 6 hours, the distance of 8 or 10 Foot, before they expose them to the Air; by which means all the parts of the Glass being insensibly and equally cool'd, there is an equal constriction of the Pores, so as that the subtil matter which can pass one of them, can with like ease pass all the rest.

VIII.
How Glass
comes to
have an
Attractive
Virtue.

Glass seems to have something of a Magnetic Virtue; for when it is strongly rubb'd, so as to be heated thereby, it draws the neighbouring Bodies to it self.

The Reason is, because the agitated particles of the 1st Element, continually pass from the Glass into the Air, and others from the Air return to the Glass, to take up the room of the former; and because those particles which return from the Air, have not all of them the same degree of Agitation, those which have less, are driven towards the little Holes; which have no correspondent Pores in the Air, and being, as it were, heaped upon one another, do constitute certain wreaths, which in process of time acquire determinate Figures, which afterwards are not easily changed. Wherefore when Glass is strongly rubb'd, so as to grow hot, these wreathed particles being driven out, are diffused indeed through the neighbouring Air, and enter into the pores of Bodies that are about them: But forasmuch as they do not there find an open and ready way for themselves, they return to the Glass immediately, and carry along with them any little Bodies they meet with in their way.

IX.
Glass be-
comes va-
riously co-
loured, by
being ming-
led with
Metals.

When in the melting of Glass, a Metal is mix'd with it, the parts whereof cannot so easily be smoothed and polished by the action of the Fire, as those of the Ashes are whereof the Glass is made, then the Glass becomes ting'd of divers Colours.

The Reason is, because the metalline particles, which are very irregular, do insinuate themselves into the pores of the Glass; and by this means, make the parts of the 2^d Element, that pass through the same, to move and roll differently from what they did before, and consequently to represent those Colours which are caused by these their different rolings.

X.
What is
the reason
of the stiff-
ness of
Glass.

Glass is very stiff, and cannot be bent without the danger of Breaking. Wherefore, if it be never so little bended one way, it presently springs back like a Bow, and returns to its former Figure.

The Reason is, because this bending doth some what change the figure of the Glass, and straitens the pores of it; so that the particles of the 1st E-

lement, that before pass through them, finding their way not so easie as before, and yet pursuing their motion as far as they are able, force the sides of them, and endeavour to reduce them to their former figure. For this property of leaping back, is not peculiar to Glass only, but to all hard Bodies, whose particles are joined by immediate contact, and not by the weaving or intangling of Branchy parts: As is evident in a bended Bow of Steel or Wood, which presently leaps back to its former state, except it have continued bent too long; and that the subtil matter hath found or made it self other passages to run through.

Glass is melted by the action of fire, and whilst it is so, is easily formed into all sorts of figures.

The Reason is, because the parts of Glass having been before worn and polished by the force of fire, are easily moved, and obliquely creeping, and flowing one upon another, they begin to touch each other in some small part of their surfaces, and following one another, constitute a fluid Body, which may be formed into any figures, according to the pleasure of the Artist. Moreover this fluid Body, as it grows Cold, becomes tough like Bird-lime, so as that it may be drawn into thin Threads; because as long as that motion is continued in it, whereby its parts do flow, lying obliquely upon one another, it may the more easily be drawn out into Threads, than it can be broken.

Glass beaten into Powder, according to the opinion of some Physicians, becomes Poison.

The Reason of this, as I suppose, may be, because the pieces of Glass are hard and sharp, which hurting and wounding the Membrans of the Stomach and Guts, as well as of the other smaller vessels, become destructive to the Body of Man. For I do take Glass, when it is yet whole, to be no Poison at all; forasmuch as many have swallowed it without any hurt; which is an argument, that all the hurt that can accrue to our Bodies from Glass, must proceed from the hardness and figure of its little particles.

XI.
Why Glass
melts by
the force of
Fire.

XII.
Glass be-
aten to Pow-
der becomes
a Poison.

CHAP. XI.

Of the Air.

THE Air is insipid, and makes no impressi-
on of Taste upon the Tongue.

The Reason is, because it swims upon our Spit-
tle, and doth not mingle with it, and therefore
cannot affect the Nerves of the Tongue. And
hence also we may see the reason why water is in-
sipid; as likewise why fat Liquors are less discerni-
ble by their taste, than dry things.

The Region of the Air, which is nearest to
the Earth, is found to be warmer than that above
it, where Cold hath a greater dominion, and
where Hail, Snow, and other cold Bodies are ge-
nerated.

The Reason is, because the Rays of the Sun be-
ing copiously reflected from the Earth, do agitate
the parts of it more than ordinary. For a violent
agitation of the parts of the Earth produceth Heat,
especially if it be caused by the Light, and do con-
tinue for some time. And forasmuch as the Rays
that are reflected from the Earth, are not in so
great abundance carried up to the higher Regions
of

I.
Why the
Air is in-
sipid.

II.
Why the
Air that is
nearest to
the Earth,
is hotter
than that
which is
further off.





of the *Air*; and those which get up thither, do communicate their motion all along to the *Bodies* they meet with, it cannot be, but that cold must succeed upon this diminished agitation, and so give occasion to the condensation of *Clouds*, and the production of *Snow* and *Rain*.

III. *How the Air may be made more heavy.*
The *Air* being thrust and crowded into any vessel, does become more heavy, than that which is diffused in a free and open place. Which G. A. LILÆUS made an Experiment of after this manner. I took, saith he, a large Glass Bottle, and carefully applied to the Mouth of it the Neck of a Bagpipe, by which means I crowded into it a very great quantity of *Air*; for because of its easie condensation, 2 or 3 Bottles full of *Air* were thrust into it over and above that which was in it at first. Now by this Experiment Galilæus learnt, that the crowded *Air* had made the Bottle more heavy than before; and that as soon as the Mouth was unstopt again, the weight of it was again diminished.

The Reason is clear and evident; because in the condensation of *Bodies*, the parts come nearer together and are more intimately joyned; And therefore being in greater quantity, they cannot but weigh more than before; for a greater quantity of *Air* makes the Vessel more heavy than a less quantity. As will be evident, if this Bottle with *Air* be fitted to another Bottle full of *Water*, with a hole at the bottom of it, which may be opened at pleasure: For when the Bottles are thus joined together, and a passage left open for the *Air* to enter into the Bottle full of *Water*, as much *Water* will run out as there was of condensed *Air* that was crowded into the other Bottle. And therefore we are to suppose, that the quantity of *Air*, that was with forced driven into the Bottle, is equal to the quantity of *Water*, that was driven out from it through the Bottle.

IV. *How much the Water is heavier than the Air.*
It seems to be difficult to determine how much the *Water* is heavier than the *Air*; forasmuch as the weight of the *Air* is not the same in all places. Yet may the same be, in some sort, determined from a late Experiment; by which, well-nigh, all the *Air* having been contracted out of the great Glass Vessel of the Pneumatick Engin, and the Mouth of it stopt, it was laid in a Scale, to know exactly how much the Vessel weighed without *Air*; and afterwards when the *Air* was let in again, it was weighed a 2d time, and then found that the Vessel weighed about an ounce and half more than it did before: So that according to this Experiment the *Water* should seem to be almost 1000 times heavier than the *Air*.

V. *A Description of the Pneumatick Engin.*
For the further clearing of this, and the following Phenomena, I think it will not be useles to give here a description of the foresaid Engin or Machin. It consists chiefly of 2 parts, viz. of a Syringe or Pump, and a Glass Vessel, which is called a Recipient, whence the *Air* is pumped. Between the Syringe and the Recipient is a Copper Pipe, through which the *Air* passeth out of the Recipient into the Syringe; and in the Pipe is a Peg, by the turning of which the *Air* is either suffered to pass out of the Glass into the Syringe, or stopt from passing. When therefore the Sucker is pulled up, the lower part of the Syringe is stopt with ones Finger, that the *Air* may pass out of the Recipient into the Syringe; and when the

Sucker is prest down, then by turning of the Peg the *Air* is hindered from passing out of the Recipient into the Pump; and by removing ones Finger, the *Air* is driven out of the lower end of the Syringe; the rest will be easily perceived by the Eye, or understood from the Figure. A is the Pump, at the bottom whereof B is a little hole, which is shut with ones Finger, when the Sucker is drawn up, by means of the Handle belonging to the indented Wheel, and of a plate of Iron also indented, which is fastned to the Sucker. When the Sucker is drawn up, the *Air* rusheth forth out of the Recipient F, through the Pipe I, into the Pump: For then by turning the Peg L, the *Air* hath an open passage afforded it into the Syringe; but when the Sucker is thrust downwards, and the Peg turned the contrary way, the *Air* is stopt from returning into the Recipient; and then upon taking away ones Finger B, the *Air* is thrust out through B, and the Recipient, by degrees, is emptied: And this pumping must be reiterated so long, until the Recipient F be emptied of all the *Air* that was in it. Having thus set down the Frame of this Engin, we will proceed to some Experiments that are made by it.

1st. After that the greatest part of the *Air*, contained in this Engin, is evacuated, the Stopple which shuts the upper Mouth of it, cannot without difficulty be removed, as being prest down with a greater weight; but is most easily removed, when by turning of the Peg the *Air* is let in again; for when that Hole is shut, the outward *Air* doth more strongly prest the Engin, than when it is open.

2dly. Upon the same Evacuation, the Sucker is very difficultly drawn upwards; but being drawn up, doth of it self run down again, tho' an 100 pound weight were fastned to it; because upon the exhausting of the shut up *Air*, which before balanced the outward *Air*, this being now become more heavy, forceth the Sucker to enter into the Pneumatick Pipe, so as that being, as it were, bound with strong Bonds, it cannot be separated.

3dly. A Square Glass Bottle, tho' it be of thick Glass, upon the evacuation of the *Air*, breaks immediately; whereas a round Glass, tho' it have a crack in it already, doth not only not break, but also keeps the external *Air* from entering into it; because, by how much the External *Air* doth more prest the parts of the Glass, the more they do mutually support each other, as we see it is in arched Roofs, so that none of them can give way: But the case is different in a Square Bottle, which hath much less force to resist, as being unable to withdraw the force and weight of the External *Air*.

Hence it is, that if you tie the neck of a Bladder, after that you have squeezed the *Air* out of it, and so put it into the Glass Recipient, upon the Evacuation of the *Air*, that was in the Recipient, you will find the Bladder begin to swell, and to that degree, that sometimes it bursts, with a great noise. The same thing may be seen in the common Torricellian Experiment: For if you put the Bladder of a Carp, almost void of *Air*, into the Pipe, it is presently blown up, because the remaining parts of the *Air*, being loosened by the neighbouring *Air* in the Pipe do extricate themselves. And therefore as soon as the *Air* is let in again into the Recipient, or into the Pipe, the swoln Bladder

Figure 20.

VI. According as the *Air* is either exhausted or let in, so the Stopple of it is either more hardly, or more easily removed.

VII. The same effect happens to the Plug.

VIII. A Square Glass Bottle breaks upon the evacuation of the *Air*.

IX. A Bladder, upon the evacuation of the *Air*, swells in the Pneumatick Engin.

immediately falls again. The same thing also happens when the parts of the *Air* are agitated by *Heat*; for we see that a *Bladder*, which is not above half full of *Air*, if it be laid near the *Fire*, is blown up to the utmost, and becomes very hard.

X.
Aqua Fortis and Vinegar do swell in the Pneumatick Engin.

Aqua Fortis, in which a *Metal* hath been dissolved, and *Vinegar* impregnated with the solution of *Coral*, do wonderfully swell in the *Recipient*, upon the extraction of the *Air*, and seem to *boil*; because the *Particles* of the *Air*, that are shut up in the pores of these *Liquors*, being set at liberty by the pressure of the *Ambient Air*, do diffuse themselves into a larger space. And so likewise it hath been observed, that if a shrivell'd *Apple*, be put into the *Recipient*, after that the *Air* is drawn out, it becomes plump up again, and looks as fresh, as if it had been but newly pluck'd from the *Tree*; and if the *Skin* of it be broke, a kind of a froth breaks forth from it, as if it were roasted at the *Fire*.

XI.
How Bullets are discharged from Wind-Guns by the compression of the Air.

The *Air* when shut up in any *Vessel*, and compressed by outward force, becomes endowed with a power to leap back or rebound, as is evident in *Wind Guns*, from which leaden *Bullets* are discharged with so great force, as they seem to exceed the force of those that are discharged by *Gunpowder*. So likewise there are many other *Engins*, which by compressing of the *Air* only, cast up waters to a great height.

The Reason is, for that when the *Air* is compressed within these *Pipes* or *Engins*, every one of its *particles* cannot enjoy that round space it stands in need of, to turn round about its own *Center*; but other neighbouring *particles* encroach upon it. And seeing that the same force of heat, or the same agitation of the said *Particles*, is preserved by the motion of the *Heavenly Globuli*, and that they cannot freely display themselves, being hindered by their neighbours pressing in upon them, they hit and push one another with their *Corners*, driving each other out of their places. And thus with united forces strive to recover their former liberty, and a larger space to move in.

XII.
What is the reason of the sudden and violent eruption of fermented Liquors out of the Bottles, where in they have been pent up.

In like manner small *Wines*, and new *Beer* or *Ale*, being put up into *Bottles*, break forth, as soon as they are opened with a great force; because the parts of the *Tartar* or *Wine-Lees*, being pent up within the sides of the *Bottles*, cannot be separated, or flee from one another; and therefore by means of their intestine agitation, do so cut and divide one another, that tho' they be mixed, yet there is no connexion between them; which is the Cause, that as soon as the *Bottle* is unstop'd, they break forth with great noise and violence, in the form of froth.

XIII.
Why a Bladder that is blown up, being struck against the ground, doth rebound again.

Thus also blown up *Bladders*, being struck against the *Ground*, do rebound again: for the *Air* being compressed in the *Bladder*, is agitated by the subtil matter, which is lodg'd between the parts of it; and striving to recover its former freedom, lifts up the *Bladder*; and being unable to bear any greater compression, beats back the hard *Bodies* it meets with. The same *Elastick Force* is clearly demonstrated, by putting a *Swines Bladder*, distended with *Air*, into the *Pneumatick Engin*; which upon the evacuation the *Air*, doth ordinarily distend it self to bursting: Sometimes lifts up 50 pound weight, because the shut up *Air* being

delivered from the weight of the *External Air*, doth endeavour a greater dilatation, and by extricating it self, takes up a greater place.

Accordingly also a reason may be given of the descent of the *water* in a *Weather-glass*, when it is hot: For the *Air* that is contained in the *Glass*, being agitated by stronger *Beams* of the *Sun*, or with more *Heavenly Matter*, doth dilate it self, and consequently bears down the *water*; which cause is no sooner removed, and the dilatation diminished, but the *water* riseth again as before.

XIV.
Why the water is prest downwards in a Weather-Glass, in hot weather.

But you'll say, if the *Air* be endued with an *Elastick Force*, how comes it to pass, that when it is shut up in thin *Glass Bubbles* or *Drops*, *Hermetically Sealed*, it doth not break through the thin *Walls* of its *Prison*?

XV.
How it comes to pass, that a weak brittle Glass can resist this Elastick force of the Air.

I Answer, that these weak *Bubbles* are not broken; because as the *Glass* is prest by the inward *Air*, so in like manner the outward *Air* dasheth against the said *Glass*, and because the force is on both sides equal, it cannot break the *Glass*. For the same reason it is, that *Bubbles swimming* on the *water*, continue whole for a considerable time without breaking; and so making way for the pent up *Air* to get out. Which could never be, without the pressure of the *Ambient Air*; forasmuch as the *Air*, by its *Elastick Force*, is able to break very thick *Glasses* to pieces.

Take a *Glass Pipe* 3 foot long, having one end of it stop'd up, and the other open, and fill it with *Quicksilver* to the top, then turn it with the open end of it downwards into a *Vessel* likewise full of *Quicksilver*, so that it may run down into the *Vessel*. And you will find that the *Quicksilver* will not descend to the Bottom of the *Pipe*, but will continue 27 *Fingers* breadths high, or thereabouts.

XVI.
How the Heaviness of the Air may be proved.

The weight of the *Air* is the cause which keeps the *Quicksilver* at the height, and doth not suffer it to sink lower. For tho' the *Quicksilver* that is in the *Pipe* be very heavy, yet can it not run down into the *Vessel* that lies under it, without raising the *Quicksilver* that is in it, and consequently the whole *Mass* of the *Air* that lies above it. Now the thick and agitated parts of the *Air*, do hinder its further condensation, because it is not without reluctance that they suffer any compression, and are reduced to a more narrow space and compass. But yet we must not imagine that every *Air* hath a like force to resist, but that the same varies according to the degrees of its *Rarity* or *Density*, that is, its looseness or compactness: For a loose and thin *Air*, and whose parts are more weakly dilated by *Heat*, is more easily bent, and doth less resist the pressure of the *Quicksilver*, than that *Air* which is more thick, and the *Particles* whereof are more vehemently expanded. And for this reason it is that the *Quicksilver* sinks lower in *Fair*, than in *Cloudy* and *Rainy Weather*, and that the *Air* which is on the top of *Mountains*, doth less oppose the driving of the *Quicksilver*, than in a *Valley* or shady place; because in this latter place the *Air* is thicker, and more weakly agitated by the heat of the *Sun*. Wherefore it is evident that the *Quicksilver* contained in the *Pipe*, is kept up by the weight of the *Air*, and that it would sink till it came to be level with that which is in the

the *Vessel*, in case it were not hindred by the weight of the *Air* that lies upon it.

XVII.
The Quick-
silver in a
Weather-
Glass is
variously
raised,
according
to the
Change
of the
weather.

Thus we experience, that when the *North-wind* blows, and it is *Fair-weather*, the *Quick-silver* riseth higher; and sometimes to 28 fingers breadths; whereas when the *South-wind* blows, and in *Rainy-weather*, the *Air* is much lighter, and the *Quicksilver* only riseth to 27 fingers breadths. Thus also by the means of *Pumps*, the higher that the *Quicksilver* is in the *Barometrum*, or Instrument to distinguish the weight of things, the higher the *water* riseth, that is, 32 foot high, when the *North-wind* blows; but during a *South* or *West-wind*, and in *Rainy-weather*, scarcely 31 foot high, and so much the less as the *Pump* is placed on higher ground.

XVIII.
The Con-
tact or
Connexion
of Bodies
is caused
by the
Heaviness
of the *Air*.

The mutual contact of *Bodies*, whence they derive their firmness and connexion, is a pregnant Evidence of the weight of the *Air*: For we find, that 2 *Marble Polisht Bodies*, besmear'd with *Oil*, do sometimes so closely stick together, that a closer Connexion can scarcely be apprehended. But no sooner are these 2 *Bodies* put into the *Pneumatick Engin*, but immediately, upon the evacuation of the *Air*, the piece of *Marble* that lies undermost, is immediately separated from the upper; because the *Air*, that lies under the Lower *Marble*, doth no longer bear it up, and is no longer able to keep it close joyned with the upper.

XIX.
How it
comes to
pass, that
sometimes
2 Marbles
stick close
together
in a place
that is
void of
Air.

And if at any time it happen, that 2 *Marbles* stick close together in a *vacuum*, the Cause is only this, because the *subtil Air*, which pierceth through the sides of the *Glass*, doth not find any entrance between 2 exactly polisht *Marbles*: And therefore the lower *Marble* cannot fall down without pressing and raising the foresaid Substance, which resists more than it can be pressed by the *Body* that lies upon it. But when *Marbles* are anointed with *Oil* or *Spirit of Wine*, that by means thereof they may be the more closely glewed together, then, as soon as the *Thicker part* of the *Air* is drawn out of the *Recipient*, *Airy Bubbles* do immediately arise from the said *Oil* and *Spirit*; which *Bubbles* being afterwards dilated by the *Elastick virtue* of the *Ethereal substance*, do separate the *Marbles*, that before stuck together.

XX.
Why a
Bladder
fill'd with
Air doth
sink the
flower, the
nearer it
comes to
the bot-
tom of the
Water.

Hence we may conclude, that a *Bladder* fill'd with *Air* requires the greater force to press it downwards, by how much the nearer it comes to the bottom of the *Water*; because the *Air* riseth the more slowly from the bottom of the *Water*, towards the *Region* of the *Air*, by much the nearer it approacheth to it. And the Reason is, because fewer parts of *Water* do lye upon it, which by lifting up the *Bladder* or *Air* from beneath, push it upwards. Wherefore, if we should suppose the *Flame* to mount up through the *Air*, quite to the Orb of the *Moon*, it would still move slower and slower, the higher it ascended; because the *fire* doth not mount upwards by any virtue of its own, but is only driven upwards by the *Air* that surrounds it. For the Parts of the *Air* that are nearer to the *Earth*, being more compress'd by those that lye upon them, they do with more force push forwards the *flame*, than when they are more remote from the *Earth*; where, because they have fewer parts pressing them downwards, they lye the

looser, and consequently drive up the *flame* more faintly.

If a *Glass-Pipe* that is not 27 fingers breadth long, after the manner as before explained, be filled with *Quicksilver*, it will not at all sink down in it; but will continue fill'd to the top, without any subsidence.

The Reason is, because the particles of the *External Air* are so agitated, and do so comply with the motions of the *Heavenly Globuli*, that they cannot be compress'd by the weight of the *Quicksilver*, that is, less than 27 fingers breadths high, and consequently do so dull its force, as to hinder its descent.

The *Water* is raised in *Pumps* by the motion of the *Sucker*; but cannot be raised above 31 foot high.

The *Water* mounts up, together with the *Sucker*, when it is drawn upwards; because there is no *Vacuum* in Nature, and all Spaces are fill'd with *Bodies*, so that there can be no motion, without a total Circulation of the *Bodies*, that are about the thing which is moved. And therefore it happens, that as soon as the *Sucker* is drawn up, it makes the *Air* that was above the *Pump*, to move about the midst of it; and that which was about the midst of it, to come into the place where the *water* is, which mounting upwards comes in the room of the *Sucker*. For the *Water* chiefly moves that way, where is the least pressure of *Air*, that is within the Bore of the *Pump*, which the *Sucker* hath left. Now the Reason why the *water*, by means of *Pumps*, cannot ascend above 31 foot, is, because the *Air*, by its natural weight, having driven up the *water* without condensation, and being afterwards unable to bear a greater weight of *water*, is by the motion of the *Sucker* shaken with greater violence than ordinary, and by this means plyes and is broken; and because the *subtil matter* is driven out above the *water* in the Bore of the *Pump*, the *water* settles at the due height of 31 foot.

And it is for the same Reason that the *water* mounts up in a *Pipe*, upon the sucking of it; for the *Air* by its weight presseth all the parts of the *Water*, or other *Liquor* that is in the *Vessel*, in which one end of the *Quill* or *Pipe* is dipt, except only those parts which are directly under the Lower-end of the *Quill*, which is opposite to the upper part of it, which is in the Mouth of him that sucks: Whereupon, as soon as the *Muscles* have lifted up the *Palat* and the *Breast*, the *Air* within dilates it self, and being dilated, is not of strength enough to hinder the *water* from entering the *Pipe*, into which the *external Air* drives it; whence it is, that when we suck through a *Pipe* of a certain length, it is all one as if the Mouth it self were extended so far. And it is by the same Reason, that an *Infant*, by applying his Mouth round the *Nipple* of his Mothers *Breast*, draws the *Milk* from it.

A *Hand* held forth in the midst of the *Air*, feels no Heaviness; tho' indeed the *Air* it self be Heavy, and consequently must needs press the *Hand*.

The Reason is, because the *Hand* is prest on every side by the *ambient Air*, and as much by that which is under it, as by that which lies upon it. For the *Air* which is under the *Hand*, is driven by

XXI.
By what
means the
*Quick-
silver* is
hindred
from sink-
ing lower
in the
Glass-Pipe.

XXII.
Why the
Water in
Pumps
cannot rise
above
31 Foot
high.

XXIII.
How Suck-
ing is
performed

XXIV.
Why a
mans *Hand*
stretched
out in the
Air, doth
not per-
ceive any
weight.

by the weight of the other parts of the *Air* that are on the sides of it. Like as the *water* which answers to the bottom of a *freighted Ship*, is driven towards the bottom of the *Ship*, by the weight of the *water* that surrounds it at the top. Seeing therefore that the upper *Pillar of the Air* hath no more Power to drive the *Hand* downwards, than the lower hath to drive it upwards; it is no wonder that we are not sensible of any *weight*, when we reach our *Hand* out into the *Air*. Hence it is also, that when we lay our *Hand* upon the *Mouth* of a *Vessel*, whence the *Air* is extracted, it begins to swell.

XXV.
Why a
Glass Vial
breaks,
when put
into the
Recipient
of the
Pneuma-
tick Engin,
after that
the Air is
exhausted.

XXVI.
Why the
flesh swells
upon the
application
of Cupping-
Glasses.

And the same Reason must be given why a *Glass Vial* being put into the *Recipient* of the *Pneumatick Engin*, after that the *Air* is pumped out of it, breaks to pieces; for seeing that there is no outward *Air* that might *repel* the force of the inward, and resist the force of its endeavouring to dilate it self, the *Air* which is within the *Vial*, bearing against the sides of the *Recipient*, hath the power to press and draw it together, and at last to break it to pieces.

And for the same Reason it is, that when the *Air* is dilated by the Flame in *Cupping Glasses* that *Chyrurgeons* make use of, as soon as the *Fire* is extinguish'd, the *Flesh* that is contain'd within the *Cupping Glass*, begins presently to swell; because that part is less press'd upon by the rarefied *Air*, than that which bears the weight of the outward *Air*. And this makes it appear, that the *Sucker* in the *Pneumatick Engin*, after that the *Air* hath been exhausted out of the *Syringe*, the under Orifice whereof is stop't, cannot be drawn up because of the weight of the *Air*. For the *Pillar of Air* which is of the same Bulk with the *Sucker*, must first be removed out of its place. But when this outward *Air* is extracted,

then the *Sucker* is without any trouble at all drawn out of the *Syringe*, tho' the lower Orifice be stop't.

The same Reason also must be assigned why *water*, that is in a *Glass* or *Cup* that is not filled to the brim, seems to be low in the midst, and more raised towards the *Edge*, as hath been already mentioned; for the middle part of the *water* is press'd on every side, but not the extreame or outside parts, upon which the *Air* exerts its force more weakly and obliquely. But on the contrary, when the *Glass* is fill'd to the top, the *water* swells in the midst. For besides that the *water* cleaves close to the sides of *Glass*, its middle parts are only compress'd by the *Air* that lies above it, whereas the outsides are press'd every way; and the *Air* that lies under it, and is beneath the *Horizontal Line*, exerts its force upon that part of the *water* which toucheth the sides of the *Glass*; which makes the *water* strive to get thither, where the pressure is weakest.

Before a *Shower* or *Storm*, the *Air* is not so heavy as it was before; and the same is when the *South-wind* blows, tho' no *Shower* follow.

The Reason of this seems to be, because the *Steams* or *Vapours* which arise out of the *Earth*, and which mingle themselves with the *Particles* of the *Air*, are precipitated, and condensed into *Clouds*: By which means the upper part of the *Air* becomes much dilated, and quitting those *Bodies* that mixed with it, becomes more thin and subtil. For there is no question to be made, but that the *Air* contains in it self many parts of *water*, from the Coagulation and Condensation whereof *Clouds* and *Showers* are formed. This appears in Mr. BOYLES *Pneumatick Engin*; for as soon as the *Air* enters the void *Recipient*, it appears, as if it were all covered with a *Mist*.

XXVII.
Why the
water that
is in a
Glass, does
sometimes
appear
lower in
the midst,
and some-
times
higher.

XXVIII.
Why the
Air grows
lighter up-
on the ap-
proach of
Stormy
Weather.

The





To the Worship- full Phillip-
Bickerstaff of Chirton in the
County of Nor- thumberland Esq.



This Plate is humbly

Dedicated by Richard Blome.

The Fifth Part

OF THE

H I S T O R Y

O F

N A T U R E.

O F

Things dug out of the Earth.

CHAP. I.

Of Metals in General.

I.
Whence the
variety of
the Metals
that are
in the
Earth
doth arise.

THE great use that *Metals* afford to the Life and Convenience of *Mankind*, may seem in some degree to excuse their *Covetousness*, who break up the *Bowels* of the *Earth* to come at them. For doth not *Gold* and *Silver* furnish us with *Money*, *Rings*, *Jewels*, and a thousand *Ornaments* and *Utensils*, for our *Cloaths*, *Houses* and *Tables*? And who is ignorant of the absolute necessity of *Iron*, or of the great usefulness of *Tin*, *Lead* and *Copper*? *Provident Nature* having so order'd it, that there should be a variety of *Metals*, suitable to our several *Necessities*.

The Reason of this multifarious production, must be fetch'd from the different *Juices* that lodge in the *Bowels* of the *Earth*, and are condensed there; for seeing that to the generation of *Metals* are required *Sharp Spirits*, *Oily Exhalations*, and the *Fumes* of *Quicksilver*; these continually ascending from the *Bowels* of the *Earth*, to the more *Exterior* parts, do there leave the *Metalline particles* they bring along with them, and according to their difference, are generated a great variety of *Minerals*, *Metals*, and other things dug out of the *Ground*. For as we find, that in the *Fruits of Trees*, the grosser Matter doth constitute such parts of them, and the more pure and *subtil*, others: So sometimes in the same *Vein* many *Metals* are generated, whereof some require a more crude and less elaborate Matter, as *Iron*, *Lead*, &c. and others a better prepared and more refined Matter, as *Gold*. Which is the Reason why a greater quantity of ignoble *Metals* are found in the *Mines*, than of the pure and noble; forasmuch as *Nature* needs much more time for the bringing these to *Perfection*, than the other.

All *Metals*, except *Quicksilver*, are *Malleable*.

This Property of *Metals*, is the consequent of their Nature and frame; for seeing that *Metals* are nothing else but *hard Bodies*, composed of many *Integral parts*, which, as to their figure are long and branchy, it cannot seem strange to any Considerative person, that they are *malleable* and *ductil* when they are forged on the *Anvil*, or drawn into *Wire*: For it may be easily conceived, that their parts being thus *figured*, may be so disposed, as that they may glide a good while one over another, or side-ways to each other, without wholly separating from one another. After this manner *Lead*, *Iron*, *Silver* and *Gold*, more than any of them, may be drawn into *Wire*, or beat into *Leaves*, of an incredible thinness.

Mines of *Metals* are chiefly found under *Mountains*, and especially in those parts that face the *East* or *South-Sun*.

The Reason is, because at the bottom of *Mountains* there be many *Cavities* and *Clefts*, in which the sublimed particles of *Metal* may unite, and mount up together to the outward surface of the *Earth*, especially in those places which are most expos'd to the *Sun*, and admit its strongest and greatest heat. For tho' the *Sun-beams* do terminate on the surface of the *Earth*, and do not penetrate to the inmost parts of it; yet is it not to be question'd, but that the *Heat* produc'd by them, doth reach to the most abstruse and inward parts of it, and most strongly affect those parts which they most directly strike against. For the *Earth*, by the heat of the *Sun*, being cleft into Gaps and Slits, way is made for the more easy mounting of the *Juices*, that are hid in its *Bowels*, and which deposit their Burthens, to wit, the *Metalline particles* they are charg'd with in the Upper parts of the *Earth*. And for the same Reason it is, that *Springs* do frequently rise at the Foot of *Mountains*, because the *water* finds a more easie passage through, and more ready ascent to them. Wherefore, whenever any

II.
Why *Metals* are *malleable*.

III.
Why *Metals* are found at the Bottoms of *Mountains*, lying East and South.

Mineral or Metal is found mingled with the Upper-part of the Earth, we may conclude, that the same was carried up thither, together with the ascending Vapours and Exhalations.

IV.
What
places do
most a-
bound with
Metals.

And this is the Reason why Metals are most frequent in those places, which are most expos'd to the Solar Rays, and which receive most of their heat; because Heat, by wasting of the moisture, makes such places full of Clefts and Slits, through which the Juices and Metalline Exhalations, may more easily ascend.

V.
Metals
first de-
tect'd by
the Burn-
ing down
of Woods.

Tho' Metals consist of several Juices, and are now generally found in the Mines; yet it seems very probable, that their first Invention or Detection was owing to the conflagration of Woods. Thus ARISTOTLE tells us, that in Spain, when some Shepherds had set a Wood on fire, which kindled the Earth also, molten Silver was perceived to run down in the same place. Neither will this seem strange to any who shall consider, that in many places the Veins of Metals are found, reaching to the Roots of Great Trees, about which they are wrapped; wherefore when such Trees are burnt down, no wonder if the said Metals, that are entangled amongst the Roots, do melt down with the heat of the fire: In like manner as in the dreadful Fire of London 1666, the Bells in some Steeples were melted.

VI.
The Ground
that is
most rich
in Metals,
appears
outwardly
most bar-
ren.

The Ground which is rich in Mines, is generally Barren: And besides exhales noxious Steams and vapours, which are very prejudicial to the health of the Inhabitants, and are the cause of many Diseases.

The Reason of this Barrenness is, because the Alimentary Juice, appointed by Nature for the Nourishment of Herbs and Plants, is otherways diverted, viz. to furnish Matter for Metals. And it is for want of this Sap or Juice, that in such places the Trees do languish, Herbs wither, and the Earth it self is bereft of its Vigour, Beauty and Ornament. These parts of the Earth also are more subject to noxious Exhalations, because of the great quantity of steams and vapours that abound within the Bowels of them. For we must not suppose, that all their Matter is spent in the making of Metals, but that the more subtil part of them being agitated by the Matter of the first Element passeth through Clefts to the surface of the Earth, and there mingling with the Air, doth infect the same, and becomes injurious to those that breath in it. This may be seen in most of the Lakes and Pools of Zealand, from whence they dig their Turf, which abound with Bitumen, and in burning give forth a nasty stink: Yea, the steams and fumes that proceed from them, do, as it were, gild over all the Furniture and Utensils of Iron, Copper, Tin and Silver, that are in the Houses where it is commonly burnt, and discolour all things but Gold.

VII.
Why Me-
tals are
found in
some Ri-
vers.

Metals are sometimes found in Rivers, according to what Historians tell us of the Rivers Tagus, Ganges and Pactolus, as abounding with particles of Gold and Silver, which are gathered by the Inhabitants, and melted down into Ingots.

We must not imagin that Metals are generated in these Rivers, as they are in the Bowels of the Earth; but because the waters of those Rivers runing through the Grounds which abound

with Metallick Veins, carry great store of their particles along with them. For Water of it self is not a fit Element for the generation of Metals, forasmuch as nothing can be expected from its union with Earth, save only a little Mud or Clay.

Metals are considerably rarefied by Heat; but are not subject to be condensed by Cold.

The Reason of this is, because Metals are already in the state of the highest compression, and have the whole weight of the Atmosphere lying upon them. Being therefore already thus compress'd, they are not capable of any further condensation; but well of Rarefaction. Thus we observe, that the Air is but little condensed by Cold, but very much rarefied by Heat; and that when ever it is freed from the weight of the Air that lies upon it, it becomes much more extended, than it can be compress'd or condensed by the most strong and effectual Engines.

When Metals are calcin'd, that is, are reduced into Powder, by the means of Corrosive Spirits, they flow in grains like Sand; but if they be melted, they run like water.

The Reason is, because in Calcination they are not resolv'd into the very least particles they are capable to be resolv'd into; but only into small grains, which are still capable of a further dissolution or division. But when the said Grains are dissolved by the violence of fire, they are divided into much smaller particles, and constitute a more continuous Body, like water.

And much for the same Reason it happens, that Metals, by reason of an Acid sulphur which abounds in them, do fly away with it, and are dissipated into fumes. For when Silver is melted with Lead, as soon as a little Brimstone is cast into it, the Silver vanisheth, and is turned into fumes, except that its flight be stop't by wet Linnen. In like manner, Copper that is mixed with a piece of Gold, and cemented with common Salt, and the Powder of Bricks, it mounts upwards, and carries up some Gold along with it; except the Pot, in which the Operation is performed, be covered. Because the Particles of the Metals are carried upwards by the force of the Fire, and do not quit their agitation, but by meeting with some cold Body.

CHAP. II.

Of Quicksilver and Brimstone.

Quicksilver, to which Chymists give the Name of Mercury, is the heaviest of all Metals, excepting Gold: And therefore all other Bodies swim on the top of it, without sinking to the bottom.

The Reason of this Ponderosity is, because there are fewer pores in Quicksilver for the subtil matter to pass through, than in other Metals: For the multitude or deficiency of Pores is the only Cause of the Heaviness or Lightness of Bodies. For tho' it might be granted, that the Parts of other Metals are of the same bulk and figure, and alike moved; yet forasmuch as they have many more Pores, they must needs be lighter than it. And this is the only Reason why Gold is heavier than Quicksilver, and sinks down in it, even because it hath

VIII.
Why Me-
tals are
more ca-
pable of
Rarefa-
ction, than
Condensa-
tion.

IX.
Why Cal-
cined Me-
tals flow
like Sand,
and being
melted, run
like water.

X.
Why Me-
tals are
resolv'd
into Va-
pours.

I.
Why Quick-
silver is
more hea-
vy than
any other
Metals,
besides
Gold.

hath fewer Pores, and doth not admit so much of the matter of the 1st Element; tho' indeed in this respect it doth not much exceed Quicksilver, seeing that the proportion between them, is as 44 to 43.

Which makes me the more admire, what ground PLINY could have to assert, lib. 33. cap. 3. that Gold is not so heavy as Lead, when experience assures us, that Gold is as heavy again, and compared with Blacklead, is as 10 to 6, and to common Lead, as 10 to 5 $\frac{1}{4}$.

Quicksilver is liquid, and except it be contained in some Vessel, it runs away like water.

The Reason is, because Quicksilver is divided into many little Particles, which are agitated by peculiar motions differing from one another, and continually shift their places. And tho' it doth not wet or moisten the Hand that handles it, yet cannot this hinder its fluidity: Because Moistness and Liquidity are not one and the same Quality, nor are they of the same Nature. For Fire is liquid, and Molten Metals flow, and yet neither of them can be said to wet or moisten. Forasmuch as nothing else is required to constitute the nature of Fluidity, but the motion of the insensible parts of any Body, or their being so loose, as to be easily put into motion by the subtil matter. The cause therefore of the Fluidity in Quicksilver is, because the Particles whereof it consists, are so smooth and slippery, that they cannot be closely compacted together, and because being thicker than the parts of the water, they scarcely afford any entrance to the Globuli of the 2^d Element, but only to that most subtil matter, which we call the 1st Element.

Hence it is said, that Quicksilver when put on the Fire, doth not become dissipated into Fumes; but being received into a Vessel, it soon after returns to the same form it had before, without the loss of any part of its weight.

Quicksilver that hath been fixed with Quicklime, being put into a coated Retort, passeth into the Recipient, and there appears in its former shape.

Quicksilver is fixed when the Particles of Brimstone, and of many other ingredients unite themselves with those of the Quicksilver, fixing the Points or extremities of their little Branches, in their Pores; and if it chance that the Particles of the Quicklime, being put in motion by the Fire, carry away with them the Particles of the Brimstone, or of any of the other ingredients, that united themselves with those of the Quicksilver, and hindred them from being moved, whether by stopping the passage of the subtil matter, or by rendring their figures too irregular, the Quicksilver returns again to its former state.

Quicksilver always forms it self into round drops.

Because the Intervals, which the Particles of the Quicksilver leave between themselves, are so little, that neither the more gross, nor the more subtil Air can enter them, and therefore can only act upon the surface of it, that is, by continually pushing back the parts of the Quicksilver towards the Center, until the said parts resist them equally on all sides; which they never do, till they form themselves into a spherical figure. Whence it follows, that the Air must of necessity make the

drops of Quicksilver more exactly round, than those of any other Liquors whatsoever.

But notwithstanding the parts of Quicksilver be thus Round, Polisht and Slippery, yet doth not this hinder, but that by means of Quicklime, Brimstone and other Ingredients, it may be fixed, by darting the extremities of their little Branches into the Pores of it, which makes the surface of them so irregular, that the subtil matter which moved them before, being no longer able to agitate them, the Quicksilver becomes changed into a hard Body.

Quicksilver seems to bear a great affection to Gold; and therefore they who are anointed with any Mercurial Ointment, if they hold a gold ring in their Mouths, the Quicksilver penetrating through the Body, fixeth it self on the Ring, and maketh it to appear as if it were Silver, but being put into the Fire recovers its former Brightness.

The Reason is, because Quicksilver, which we have said to be a Fluid Body, and to have its parts in continual agitation, by a moderate heat doth exhale, and fly away into Fumes, and therefore being mixt with those Steams, which together with the Breath are thrust forth from the Lungs, it is carried upwards to the Mouth, where meeting with the ring, which is a compact and cold Body, it is stopt there, and by the union of its parts returns to its former state. Much after the same manner as water, in an Alembick by heat is turned into Vapors, till meeting with a cold Body, it loseth its agitation, and is changed again into the form of water. The Quicksilver therefore doth not attract the Gold, as some suppose, but only cleaves to it, and by thrusting it self into its Pores becomes coagulated again, and recovers its former state. And therefore Physicians advise those that have been anointed, with such Mercurial Ointments, to keep a ring of Gold in their Mouths, or to take Gold inwardly, that the Fumes of the Quicksilver may stick to it. And therefore those persons, who do frequently handle Quicksilver, as those who Guild Metals, or are employed in Chymical operations, do commonly hold a piece of Gold in their Mouths, to catch the Fumes of Quicksilver, which otherwise might prove dangerous to their Bodies.

But you'll demand of me, why the evaporating Fumes or Particles of Quicksilver, do rather tend towards the Gold, than any other way.

The Reason is, because the most subtil parts of the Quicksilver, being carried away by the agitation communicated to them, betake themselves that way, where they find it most easy for them to continue their motion; and it is certain that they can pursue the same more readily in the Gold, than in the Air, because there is nothing in the Pores of the Gold that doth oppose them, whereas the Particles of the Air do continually thwart and cross their tendency. And accordingly we find, that when we handle Quicksilver with one Hand, and have Rings on the other, the same presently become discoloured by the Quicksilver.

Whereas formerly the Spaniards at the Mines of Potosi in Peru, did separate the Gold and Silver from the Dross, with incredible charge and labour, Fernandes de Velasco taught them a more compendious way, which they ever since put in practice,

VI.
How Quicksilver may be fixed.

VII.
Why a Gold Ring attracts Quicksilver.

VIII.
Why Quicksilver betakes it self to Gold.

IX.
Gold and Silver are delivered from their dross by the means of Quicksilver.

II.
What is the cause of the Fluidity of Quicksilver.

III.
Quicksilver loseth nothing of its weight.

IV.
How Mercury may be fixed, and afterwards reduced to its liquid state again.

V.
Why the drops of Quicksilver are round.

to their great profit and advantage. He took *Quicksilver* and *Salt*, which he mixed with the *Mine*, and so put them together into close covered *Pots*, which he placed in convenient *Furnaces*, and by this means the *Gold* and *Silver* uniting themselves with *Quicksilver*, became separated from their dross, the *Amalgama* or mixture of the *Quicksilver*, and *Silver* being afterwards cleansed, and made bright by reiterated *Lotion*.

X.
Litharge mortifies the sourness of Vinegar.

Litharge when put into *Vinegar*, doth take away its sharpness, and communicates a kind of sweet taste to it.

The Reason is, because the sharp pointed and unequal *Particles* of *Vinegar*, which do constitute its sourness, cleaving to the *Particles* of the *Litharge*, are thrust down to the bottom with it, and therefore no wonder, if the *Vinegar* being freed from those sharp pointed *Particles*, which prick the *Gums* and *Tongue*, appear to be of a sweetish taste.

XI.
Sublimate loſeth all its corrosive acrimony, by being ſublimed with Quicksilver.

If to *Mercury Sublimate*, which is extremely corrosive, an equal quantity of *Quicksilver* be added, and exposed to *Sublimation*, the *Sublimate* loſeth all its venomous corrosiveness, and becomes insipid, and a good *Medicine* in many cases.

Because the added *Particles* of *Quicksilver*, become increased in bulk by the *Particles* of *Salt* that are in *Sublimate*, by which means they become thicker, and their *Points* are blunted. After the same manner as when *Spirit of Vitriol*, and *Oyl of Tartar per Deliquium*, when mingled together lose all their sharpness: For these *Salts* being of different kinds, the one an *acid Salt*, and the other an *Alkali*, are no sooner mixed, but they act upon one another, by which means both their *Points* are blunted, much in like sort as when by rubbing the edge of one *Knife* against the other, both thereby become blunted.

XII.
Quicksilver taken inwardly, in any considerable quantity cauſeth Death.

If a considerable quantity of *Quicksilver* be taken inwardly, it endangers the *Life* and often cauſeth *Death*.

The Reason is, because *Quicksilver* being a very Heavy and fluid *Body*, doth easily enter the *Veins*, and mingling with the *Blood*, doth interrupt or quite stop its motion. Forasmuch as by the weight of this *Metal*, the *Blood* becomes so condensed, and its motion so much retarded, that it cannot furnish *Spirits* enough to the *Brain*, for the supply of the *Nerves*. For the *Particles* of the *Quicksilver*, lying upon one another because of their weight, do condense the *Blood*, and stop its agitation; and by this means, so small a quantity of *Spirits* are conveyed from the *Brain* to the *Nerves*, that they can only interruptedly, and by intervals fill and distend the *Muscles*. And this is the true cause, why those who get *Quicksilver* out of the *Mines* have their *Gums* flaggy, and their *Teeth* loose, because the *Mercury* entering into the inmost parts of the *Body*, doth destroy and weaken their connexion.

XIII.
Quicksilver is very hurtful to the Body of Man by reason of its Acidity.

The *Miners* that labour in the *Quicksilver Mines* of *Carinthia*, and others who are much conversant about *Quicksilver*, are generally subject to those *Diseases*, which are caused by the excessive use of *Acid things*, as with the *Palsy*, shaking of the *Limbs*, and other such like *Diseases* which affect the *Nerves*. For *Sourness* and *Harshness*, seems to be predominant qualities in *Quicksilver*. For by its *Acidity*, it doth corrode most *Metals*;

and being mixed with *Vitriol* and *Salt*, doth provoke copious *Salivation*; but when *Alkalious* or *Lixivious Salts* are mixed with it, it *Salivates* less, because these do mortify the force of *Acids*. And tho' these *Miners* fasten *Bladders* to their *Mouths*, to keep off the poisonous fumes of this *Metal*, yet they commonly dye of the *Consumption* or *Palsy*; because *Mercury* by the tenuity of its parts, doth attack the original of the *Nerves*, and relaxes the *Veins*, and above all the *Lymphatick Vessels*.

Whence we may take notice that *Quicksilver* then chiefly exerts its *Virtue*, when it is divided into the smallest *Particles*. For seeing that its parts are very *Penetrative*, they disturb the *Mass* of the *Blood*, excite *Fermentations*, and frequently hurt the *Members* of the *Stomack*, whence *Bloody Fluxes*, *Vomiting of Blood*, and terrible *Gripes* do proceed. Because the *Blood*, which by a continual *Circulation* runs through the *Body*, not being able to endure this troublesome guest, and finding it self unable to discharge him by *Sweat* or *Urin*, because the *Pores* of the *Skin* and *Kidnies* are too small for that purpose, sends all away by the *Celiacal Arteries*, and so cauſeth a *Bloody Flux* or violent *Loosness*.

XIV.
How Mercury operates upon the Body of Man.

Brimstone is found in great quantity, in the Country about *Sienna*, and in several *Islands* in *Sicily*, and in *Naples*, which abound with *Subterraneous Fires*.

XV.
Why Brimstone doth abound in the Country about Sienna in Italy, in some Islands in Sicily, and in Naples.

The Reason is, because the *Branchy Particles* of the *Exhalations*, which in conjunctions with those of sharp and *Metallick pieces* do constitute *Brimstone*, are put into motion by the force of the *Subterraneous heat*, and carried upwards to the surface of the *Ground*, where they are coagulated into a fat and oily concretion, which we call *Brimstone*. And for the same reason it is, that *Grease* and *Fat*, which likewise consist of soft and thin *Particles*, do affect hot places, as abounding most in those parts, where the heat is strongest, as about the *Heart* and *Reins*, and other such like where the heat abounds most. And as the *Fat* or *Grease* is generated in the *Bodies* of *Animals*, so is *Brimstone* formed in the *Earth*, when the most *Oily parts*, by heat are carried up, and become condensed about the surface of the *Earth*.

Brimstone is very apt to be kindled, and in a moment, as soon as it toucheth the *Fire*, breaks forth into a *Flame*.

XVI.
Why Brimstone is so inflammable.

The Reason is, because it consists of the *Particles* of sharp Juices, which are so intangled with the thin, and close *Branches* of an *Oily matter*, that many of the *Pores* between the said *Branches*, can only transmit the *Particles* of the first *Element*. Now it is evident, that the most thin parts are first put into motion, and seized by the intercurrent matter. And therefore *Brimstone* is judged by *Physicians* to be hot in a high degree.

But yet we are told, that a kind of *Red Brimstone* is dug up in *Carniola*, which neither burns like other sorts of *Brimstone*, nor hath a stinking smell, but when it is put to the *Fire* it melts like *Wax*. And therefore the *Romans* and *Grecians* made use of this in the *Expiation* and *Lustration*, of their Houses and other Places.

CHAP. III.

Of Salt.

I.
Of the several sorts of Salt.

There be different kinds of *Salt*, which do vary according to the different places of their *Generation*. There is one sort of *Salt* that is dug out of the ground, and is called *Salt Gem*, which is either taken up with *Sand*, or cut out of *Rocks*. For there are *Mountains* of *Salt* in several places, where *Salt* is cut, as *Stones* out of a *Quarry*, and grows again. Not far from *Afracan*, there are 2 *Mountains* so vastly great, and so abounding with *Salt*, that tho' every day 20000 great pieces of *Salt* are cut out of them, yet they do not appear the least diminished, the same quantity still growing up in the stead of that which was taken away. Another sort is that we call *Sea Salt*, which is made by conveying the *Sea-water* into certain *Beds*, where by the heat of the *Sun* it is turn'd into *Salt*, by the evaporation of its watry *Particles*. The last is *Spring* or *Fountain-Salt*, which proceeds from *Salt Springs* or *Well-water*, and is boiled into *Salt*. All the difference between *Salt* that is dug out of the ground, and *Sea* or *Spring Salt*, is this, that the first of these, hath no watry parts mingled with it, and therefore doth not stand in need of any evaporation, as the other two sorts do.

The Reason of this difference is, because the *water* consists of 2 sorts of *Particles*, the one *Flexible*, the other *Inflexible*, which tho' they be confounded together, and constitute only one *Body*, yet do each of them retain their several *Nature*; and are never so closely united, but that they may be separated by means of the *Fire* or the *Sun*. When therefore the *Sea water*, which hath been conveyed into *Beds*, yields *Salt*, this is not because the *Particles* of the *water* are coagulated into *Salt*, as some suppose, but by the separation of them, forasmuch as the *Flexible* and *Fluid parts* are evaporated into *Fire*, leaving the *Stiff* and *Inflexible* behind them. Whence we may conclude, that the different kinds of *Salt* that are in the *World*, are such, because of the different figure of their parts: For the *Particles* of some *Salts* are like *Cylinders*, that is, round and long, of an equal thickness: Whereas others terminate in a *Point*, as may be experienced by the dissolution of them; and therefore an *Acid Salt*, will dissolve a mixt *Body*, which another cannot penetrate.

II. How Salt is generated in the Mountains.
Salt is generated in *Mountains*, when the *Salt water* being conveyed thither in great abundance, and separated from the flexible *Particles* of the fresh *water* running another way, the *Salt Particles* only remain in the cavities that happen to be there, and continually encreasing by the afflux of new *Sea water*, do at last wholly fill them up.

III. Why Salt water is Transparent.
Salt water is more Transparent than *Fresh water*; as appears, in that the *Bodies* that are in the *Sea*, are more distinctly perceived, than in *Fresh water*.

The Reason is, because the matter of the 2d *Element*, which is contained within the *Pores* of *Salt water*, doth retain more of its motion, than that which passeth through the parts of *Fresh water*, and consequently is more fit to transmit the action of *Lucid Bodies*. For *water* is therefore

only said to be Transparent, because the *Substantial matter* which fills the *Pores* of it, can transmit the action of *Lucid Bodies*.

All *Salts*, not only those of different kinds, but also those that are of the same kind, do differ in their *Virtues*. For we find, as was said before, that an *Acid Salt*, will dissolve a mixed *Body*, which other *Salts* of the same kind, cannot penetrate nor dissolve.

The Reason is, because the insensible parts of an *Acid Salt*, are of different sizes and figures, according to the different size and figure, of the strait *Pores* of the inward part of the *Earth* where they are formed. Therefore it is that *Vinegar* dissolves *Lead*, which the *Stygian waters* cannot do: And *Aqua fortis* dissolves *Mercury* or *Quick-silver*, which *Vinegar* cannot penetrate: *Aqua Regalis* dissolves *Gold*, which *Aqua fortis* will not touch; and on the contrary, *Silver* is dissolved in *Aqua fortis*, which cannot fasten upon *Gold*. Now the reason of this variety of effects is, that amongst these *Acid Salts*, some have long, thick and stiff points, whereas those of others are short, thin, and somewhat flexible, wherefore also their *Virtues* must needs be different.

Nitre or *Saltpeter*, which in many things agrees with common *Salt*, increaseth the heat of *Fire*, and strengthens the coldness of *water*.

The Reason is, because the *Needle-like Particles* of *Nitre* are much more stiff than the sharp pointed *Particles* of the *Fire*, which are flexible, and therefore when these stiff *Saline Needles*, are mingled with those of the *Fire*, and are whirled about with them, they do much more strongly waste and consume, than the *Fire* which hath none of these mingled with it. And on the other hand, when these *Saline Needle like Particles*, fix their points into the *Liquid Globuli*, they retard their whirling about, and sometimes quite put a stop to it, and by this means it is very probable, that they promote congelation. Neither ought this diversity of effects be matter of any greater wonder to us, than when we see the same heat to soften *Wax* and harden *Clay*.

Nitre cannot be set on *Fire* by the most intense heat, but with a *Flame*, or a burning *Coal*.

The Reason is, because there can be no *Flame* without *Brimstone*. Now we find, that as soon as any *Brimstone* is cast into a *Crucible*, wherein melted *Nitre* is, a *Flame* immediately breaks forth from it, because the volatile parts of the *Nitre*, do afford a vehicle to the *Brimstone*, by means whereof it flies away in the form of a *Flame*. And this is the reason, why *Nitre* cannot be kindled into a *Flame*, by the most violent heat, but only by *Flame*, or by casting of a burning *Coal* into it.

Common *Salt* being cast into the *Fire* in whole *Grains*, crackles, but when beaten into *Powder* it doth not; as neither doth that which is generated in *Lakes*, by the heat of the *Sun*.

The Reason of this is, the rarefaction of the fresh *water*, which is pent up within the *Grains* of *Salt*. For seeing that the parts of *Salt* that constitute these *Grains*, are only confusedly joyned together, without any intimate contact, they leave room enough, for some *Particles* of fresh *water* to come between them, which as long as they are not agitated, do continue there crowded together.

IV. Whence the different Virtue of Salts doth arise.

V. Why Nitre increaseth the heat of Fire, and strengthens the cold of water.

VI. Why Nitre cannot be kindled but by a burning coal, or Flame.

VII. Why common Salt crackles when it is cast whole into the Fire, but not so when it is beaten small.

together: But when they begin to be tossed by a violent heat, they dilate themselves, and breaking their *Prison walls*, make their escape with a noise. But the smaller *Powder* of these *Grains*, as likewise that *Salt*, which is coagulated on the surface of *Lakes*, do not make any crackling noise in the *Fire*, because their *Prison walls* are already supposed to be broken, and contain no *water*, that might be rarefied by the *Fire*. And hence also it is, that the *Particles* of *Salt* that have been dried with a slow *Fire*, do not melt without great difficulty, because they are destitute of all manner of moisture, and have no *Liquor* remaining, to promote their *Fluxing*.

VIII.
Salt easily
turns to a
Liquor.

Common Salt, *Nitre*, *Salt of Tartar* and any other such like, turns to *Liquor*. Thus the *Salt of Tartar*, for Example, being set in a *Cellar* in the Summer time especially, on a shelving plate, or dish, dissolves into a fattish kind of *Liquor*, which *Chymists* call the *Oyl of Tartar per Deliquium*.

This effect must be ascribed to the watry *Particles* that fly in the *Air*, under the appearance of *Vapours*. For *Salt of Tartar* being very ponderous, it is easily penetrated by the watry *Atoms* that are in the *Air*, and which afterwards agitating the *Particles* of the *Salt*, do separate them from one another.

IX.
Why com-
mon Salt
Melts be-
ing exposed
to the Air.

For the same Reason it is, that common *Salt* melts when it is exposed to the *Air*; not as if the pure *Air*, which consists of thinner parts, were able to put the parts of *Salt* in motion, which it toucheth; but this is done by the *Particles* of *water*, that fly up and down in the *Air*, in the form of *Vapors*; and hence it is, that *Salt* seldom melts, except the *Weather* be inclined to moisture.

X.
Why distil-
led Salts
dissolve
Metals.

Acid Spirits distilled from *Nitre*, common *Salt*, *Alom*, *Vitriol*, &c. dissolve all manner of *Metals*.

Because the *Dart-like Particles* of these distilled *Salts*, entering the *Pores* of the *Metals*, do cut and tear them to pieces: For the insensible parts of these distilled *Salts*, being in a continual motion cannot enter the *Pores* of these *Bodies* without dividing, and breaking them to pieces.

XI.
Whether
flowers may
be raised
from their
Salts.

Chymists boast, that they can resuscitate the *Flowers* of *Plants* from the *Salt* that is extracted from them, and restore them to a new life.

Tho' this be confidently asserted by some, yet I take it only to be a figment, without any sufficient ground or Foundation. For we experience, that the *Spirits* distilled from *Vegetables*, are endued with very different *Virtues* from those that are in the *Plant*, whence they were extracted. Thus we find that *Vinegar*, *Brandy* and *Wine*, which tho' they be the product of the same *Grapes*, yet differ so much in their *Virtues*, as that they seem to have nothing common with one another.

XII.
Whence it
is that the
Sea water
seems to
sparkle by
night.

The *Sea water*, more especially at sometimes, seems to sparkle in the night.

The Reason is, because the *Particles* of *Salt* being stiff, and not in a condition to be bent or made pliable by the *Action* of the subtil matter, when they dash against a *Rock*, or meet with any hard *Body* in their way, these *Saline Particles* do extricate themselves, from those of the fresh *water*, with which they were wrapt about, and thus standing singly, and at some distance from one another,

they produce the appearance of sparks of *Fire*, not unlike to those that are struck out of a *Flint*. But yet all the *Saline Particles*, that are in the *Sea water*, do not produce this effect, but only those that move with their points forward. Which is the reason, why these sparks are not seen in all *Waves*, nor in all the *Drops* of one and the same *Wave*.

Salt put upon the *Tongue*, as soon as it begins to be dissolved by the *Spittle*, doth prick and pierce it.

XIII.
Why Salt
pricks and
vellicates
the Tongue.

Because *Salt* chiefly consists of slender and stiff parts, which bristling their points, do slash and cut the *Pores* and *Fibres* of the *Tongue*. For the *Saline Particles* are like so many small *Darts*, which entering the *Pores* of the *Tongue*, do with great force vellicate and rend the parts of it. Wherefore they who will not admit that a *Salt* Taste doth consist in this, that the parts of the *Salt*, do with their Points prick the *Pores* of the *Tongue*, forasmuch as they think they might as well touch the *Pores*, and *Fibres* of the *Tongue* sideways only, without penetrating them with their Points, ought to consider, that a *Needle* doth not prick but with its point, nor a *Sword* cut, but with its edge, the other parts of either of these being unable to inflict any wound: So that since a great many of these Points, are found in every crum of *Salt*, it can no more be conceived, that when the same melts in the *Mouth*, it should strike none of its little *Darts* into the *Pores* of the *Tongue*, than it can be imagin'd, that a *man* should be able to walk with his *Feet* upon *Thorns*, without being hurt by them.

Salt preserves *Flesh* from Corruption, and in time makes it to grow hard.

XIV.
Why Salt
preserves
Meat from
Corruption.

The Reason hereof may be gathered from the foregoing discourse; for the parts of the *Salt* entering point-wise into the *Pores* of *Flesh*, do not only rid it of the moisture it did abound with; but besides are like so many *Wedges*, driven in between the parts of it, where continuing unmoveable, they support the same, and hinder the more slippery and plying parts of the *Flesh*, to drive the others they are mixt with, out of their places, and by this means reduce the *Body* to Corruption. *Salt* therefore preserves *Flesh* and other things from Putrefaction, by the hardness and inflexibility of its parts; even as *Boards* are strengthened, and made more firm with *Nails*, and as the stiffness of a *Sword* keeps the Scabbard from breaking.

Thus we read that a *Girl* in *Holland*, by eating too much *Salt* became so stiff, and of so dry a Temperament, that she could no longer move the *Members* of her *Body*. And from a parity of reason it is, that the *Venetians* to harden the *Wood*, wherewith they design to build their *Ships*, whilst they are yet green, do lay them in *water*, and keep them there for many years; because by this means the *Salt Alkali*, is hindered from exhaling, by which means the *Wood* is made more hard, and less subject to Corruption.

XV.
Salt makes
Bodies hard.

Common Salt helps and furthers the Concoction of *Meat* in the *Stomach*, and that because it doth penetrate and divide it by degrees, and so disposeth it for its more ready and speedy Concoction, by the *Ferment* of the *Stomach*, and its reduction into the form of *Chyle*.

XVI.
How Salt
promotes
the Con-
coction of
Meat in the
Stomach.

Tho'

XVII.
Salt makes
the water
liquid.

Tho' Salt makes some Bodies harder, yet it makes the water more liquid; for the parts of the water being long and pliable, they can easily twirl themselves about those of dissolved Salt, which are long and stiff; which greatly facilitates their motion, because they move always bended, after one and the same manner: And it is for this Reason, that Salt hinders water from freezing, as Experience teacheth us.

XVIII.
Salt makes
the Earth
fruitful,
and pro-
duceth
the same
effect on
fat or Cor-
pulent
Women.

Salt conduceth to the Fruitfulness of the Earth; and fat and corpulent Women, who for the most part are barren, by the moderate use thereof, become fruitful.

The Reason is, because Salt penetrating into the pores of the Ground, doth suck up the noxious moisture. For Salt hath a signal drying virtue, as hath before been mention'd: And therefore when an Old Vine begins to grow barren, if old Urine be poured to the Roots of it, it will become fruitful; for being before choaked with over-much moisture, the salt that is in the Urine communicating a new heat to it, which dries up its superfluous moisture, makes it to bring forth copious and fair Fruit. And for the same Reason, the moderate use of Salt may be of good use, to make fat and corpulent Women fruitful; because Salt, by its drying, heating and absterfve quality, corrects and removes the superfluous moisture of the Womb, which otherwise might hinder the most Spirituous parts of the Masculine Seed from reaching the Female Ovarium. It is also notorious, that Salt, by its acrimony, excites Lust not only in Women, but also in Men. Now that Salt is a great promoter of fruitfulness, may be proved from that prodigious increase of Mice and Rats which is observed in Ships; and because Women that are employed about Salt-works, are commonly more fruitful than others. And so likewise it is found, that the frequent eating of Oysters, Shrimps, Lobsters, Crabs, and other Shel-fish, do stimulate Venery. For tho' Salt of its own Nature be hard, and being destitute of all motion, may be said to be Cold; yet if we consider it with relation to the effects it produceth in the Blood, and the whole Body, we must denominate it hot, because it greatly excites and increaseth the heat of the Blood; forasmuch as it is a great promoter of Fermentation.

XIX.
A Grain
of Salt,
mixt with
the Oil of
a Lamp,
hinders it
from being
so swiftly
consumed.

A Grain or 2 of Salt being added to the Oil that is in a Lamp, hinders it from being so soon wasted, as otherwise it would.

The Reason hereof is, because the Salt being shaken with the heat of the Lamp, becomes dilated, and communicates some adstringent particles, which being conveyed to the wick, give some stop to the Oil in its passage, and prevent its ascending and evaporating so suddenly, as it would, if there were none of these saline Particles to hinder it.

CHAP. IV.

Of Gold.

I.
Why Gold
is yellow.

GOLD is of a yellow Colour, and the same very bright and pleasant.

To understand the Reason of this, we are to consider that the Nature of Colours consists in this, that the Particles of the subtil matter that transmit the Action of the Light, are differently re-

ceived, by reason of the greater or lesser Roughness or Smoothness of the Bodies they light upon, and according as they obtain a stronger or weaker agitation from the manner or modification of their Reflexion; that is, according as the force of the rotation of the Globuli, that constitute the Rays of Light, doth exceed their motion in right Lines; or on the contrary. Thus, because the particles which constitute the Texture of Gold, are so very rough and solid, as to produce a reverberation, whereby the Globuli are less twir'd round, than when they produce a red Colour, and less than when they represent a white; this makes the surface of Gold to appear of a yellow Colour. For a yellow Colour seems to be nothing else, but a mixture of white and red, as may be proved by the mingling of a red Liquor with a white, whereupon a yellow Colour will ensue.

Gold struck with a Hammer, or other Instrument, yields a dull sound.

II.
Gold struck
yields a
dull sound.

The Reason is, because Gold hath but a few Pores, and those small ones too; and seeing that the Aery matter contained in them, is the vehicle of the Sound, when the Body is struck upon, it is very evident, that where the quantity of Pores is less in largeness and number, there must also be a less concussion of the Air, and consequently a weaker impression made upon the Organ of Hearing.

Gold being melted by the violence of Fire, is not the least diminished thereby, or loseth any thing of its weight or bulk. Hence proceeds that Common Saying of the Chymists, Gold cannot be destroyed by Fire; for tho' it should continue for some Ages in a Furnace, it would not suffer any perceptible loss thereby.

III.
Why Gold
cannot be
consumed
in the fire.

The Reason is, because Gold consists of such thin particles, and those so firmly woven together, that they cannot be separated from one another. For tho' Gold, as well as all other Bodies, hath pores for the free passage of the most subtil matter; yet doth it not admit the Globuli of the 2d Element; which makes it extremely solid, as containing a great quantity of thick matter under a small bulk and surface. Now the solidity of any Body consists in nothing else, but the close connexion of its parts, and the small number of its pores, both which make a Body indissoluble by any outward force.

Such is the weight of Gold, that it far exceeds that of the most heavy Bodies. According to the Paris Pound, a Foot square of it weighs 1368 pound: And compared with other Bodies, according to the calculation of some Curious Enquirers, if so much Gold weigh 100 Pound, the like quantity of Quicksilver will weigh 71½; Lead, 60½; Silver, 54½; Copper, 47½; Iron, 42; Common Tin, 39; Loadstone, 26; Marble, 21; Common Stone, 14; Crystal, 12½; Wax, 5; Oil, 4½.

IV.
Gold is the
Heaviest of
all Bodies.

The Cause of the great Heaviness of Gold is, because its Terrestrial and Aqueous parts, or, if you will, its Sulphur and Mercury are more perfectly and exactly mingled, than in any other Bodies; which is the Cause also, why their pores are less both in number and bulk: For besides this compression and compaction of the parts, we can allow of no other thing to be the Cause of the Heaviness or greater weight of Bodies.

Neither

V.
When the
malleabi-
lity and
ductility of
Gold doth
proceed.

Neither is there any *Body* that is more capable of being divided and dilated, than *Gold* is, seeing that one *Ounce* of it only, as *PLINY* informs us, may be beat out into 750 *Leaves*, each of them being 4 *fingers-breadth* square: Yea, sometell us, that an *Ounce* of *Gold* may be beaten out to that degree, as to cover 10 *Acres* of *Ground*. But tho' this extension of *Gold* into *Leaves* be very surprizing; yet is it not to be compared with that Extension which the *Wire-Drawers* give to it. For one single grain of *Gold*, will yield a *Thred* of 400 *Foot* long; so that proportionably an *Ounce* will afford a *Thred* of the length of 230400 *Foot*.

The Cause of this vast Extensibility must be ascribed to the softness of its parts, and the singularity of their Texture; for the softness of the parts of *Gold*, makes them to yield without separation, so as that those parts which before were close and compact, are now drawn out at length. We experience something like this in *Potters-Clay*, and *fat Earth*, wherein tho' there be less of Extension, yet may they, by reason of their softness, be dilated into a considerable amplitude, according to the degree of their closeness and solidity, which furnisheth a sufficiency for the Matter to be extended, and enlarged into a vast capacity of figure. For the closeness and compactness of a *Body* doth furnish parts, which the more they are diminished in depth, the more they grow in breadth. Thus *Geometricians* demonstrate, that there may be figures of equal capacity, which yet are of an unequal compass: So that amongst equally capacious figures, those which do most deviate from a *Spherical figure*, do acquire a greater compass, without any increase of their Capacity, but only differenced according to Length and Breadth; whereas before it was gathered together about a Common Point.

VI.
The Connexion of the Parts, doth greatly hinder its divisibility.

The peculiar Connexion which there is between the Parts of *Gold*, doth also greatly oppose their division and separation from one another: So that how much soever it be attenuated with a *Hammer*, or any other Instrument, it still retains the Connexion of its parts; and tho' it be not without some little pores, yet are they so entangled and woven together, and become pervious, that the particles of *Liquor* may run every way through them.

VII.
Why Gold suffers no diminution in the Fire.

From the said close Connexion of the Parts of *Gold*, it is, as was said before, that it suffers nothing by the *Fire*; for tho' the parts of it being put into motion by the *Fire*, constitute a liquid or fluid *Body*; yet hath not the *fire* the power to separate any of them from one another, or to make them fly away into the *Air*. Provided it be pure *Gold*, such as is that which is found in the River *Hebrus* in *Thrace*, *Pactolus* in *Lydia*, *Tagus* in *Spain*, and the River *Po* in *Italy*. For whatsoever the *Fire* can separate from *Gold*, is something that is of a Foreign and Heterogeneous Nature to it, not being able to diminish or separate the least Integral part of it.

VIII.
Neither can it be destroyed or spoiled by all the Corrosive

And the same may be said of *Stygian-water*; for tho' these do with great ease dissolve and corrode other *Metals*; yet cannot they enter the impregnable Fortrefs of *Gold*, nor with their Dart-like particles, loosen the Texture of its Parts. And tho' *Gold* may be dissolved in a peculiar *Stygian-*

water, called by Chymists *Aqua-Regia*, as shall be said hereafter; yet is not the *Gold* in the least prejudiced by this Solution, or essentially changed: But may be restored to its former Condition, by pouring some drops of *Oil of Tartar*, into the Solution, with some *Common-water*, whereupon the *Gold* will fall to the bottom, and quit the particles of *Salt* which kept them suspended in the *Menstruum*.

Molten *Gold*, or that which is only heated, doth scorch more violently than other *Metals*, and preserves its heat longer.

This Effect is also to be attributed to the Cohesion of its Parts; which being fat, and most closely compacted together, do long retain the fire that hath once entered them, and burn the Bodies that touch them more vehemently. For seeing that the Pores of *Gold* are very small, and only make way for the Matter of the first Element, the Fiery particles become so entangled in them, that notwithstanding their most swift and rapid motion, they cannot in haste disentangle themselves again; which is the reason that the effect of them is so vehemently imprest upon combustible Bodies that touch it.

The Corrosive Spirit, called *Aqua-Regia*, which is distill'd from equal parts of *Nitre* and *Vitriol* dissolves *Gold*; but not if you add thereto an 8th Part of *Common Salt*, or a 4th Part of *Sal-Armoniack*; for then it dissolves only *Lead* and *Silver*.

This proceeds only from the various Texture of these *Metals*: For *Gold* hath its pores so disposed, as that the particles of *Nitre* and *Vitriol* may easily enter them, if they be alone without any mixture of common *Salt*, because of the likeness of figure that is between them. Whereas on the contrary the pores of *Silver* are so ranged, that they cannot admit the particles of *Vitriol* and *Nitre*. But the particles of *Common Salt* or *Salt-Armoniack* being mixed with the *Vitriol* and *Nitre*, do so change the disposition of the parts of the *Menstruum* or Dissolvent, and make them so stiff, as to be able to thrust themselves into the pores thereof, and to dissolve it. There is also another sort of *Aqua-fortis* made of *Nitre*, *Alom* and *Vitriol*, which dissolves *Silver*, and is used for to separate it from the *Gold* that is mixed with it, which it doth not touch. For the particles that are in these corrosive Spirits do dissolve the connexion, which was between the particles of *Gold* and *Silver*; and that because of the different sorts of little Bodies that are found in these *Stygian-waters*, whereof some do agree with the particles of *Silver*, and disagree with the particles of *Gold*; and others, on the contrary, have an Analogy with the particles of *Gold*, but do not harmonize with those of *Silver*.

Gold reduced to Powder after a certain manner, and being afterwards kindled, gives a great Report, and like *Thunder* pierceth and breaks through whatsoever stands in its way, and therefore is called *Aurum-fulminans*, or *Thundering-Gold*.

This Effect will not appear so strange, if we consider the manner how this Powder is prepared. For first the *Gold* is dissolved in *Aqua-Regia*, and afterwards is precipitated with *Oil of Tartar*, and being taken out and dried, affords a Powder, which when it is heated by the fire, breaks forth into a flame.

Spirits of the Chymists.

IX.
Why heated Gold doth burn and scorch more intensely, than any other Metals.

X.
How Gold comes to be dissolved in Aqua-Regia.

XI.
Why the Chymical Preparation, called Aurum-fulminans, doth make such a great Report, when it is fired.

Flame, with a vehement noise: For all the *particles* of the *Powder*, being kindled in one and the same moment, the force of the *Flame* proceeding from them, opens the *pores* of the neighbouring *Bodies*, and dissolves the contexture of their *parts*, to make way for the *Gold* that is flying away, which breaks forth with that suddainness and violence, that it seems to imitate the noise of thunder, and the quick *Flame* of *Lightning*, both at once.

XII.
Aurum fulminans
exerts its
force up-
wards, as
well as
downwards

Some have supposed, that the force of this *Aurum fulminans* did only tend downwards: But this is a mistake, and the contrary may be proved by experiment. For if we put 2 grains of this *Powder* into a *Silver Spoon*, and cover it with a *Crown Piece*; as soon as the bottom of the *Spoon* is made hot by holding a lighted *Candle* under it, we shall find not only a deep dint made in the *Spoon*, but also that the piece of *Mony* is carried upwards. Which is an evident argument, that the force of this *Powder* doth not only tend downwards, but is diffused every way.

XIII.
How this
Action of
Fulmina-
ring Pow-
der may be
explained.

This *Powder* is composed of 3 parts of *Nitre*, 2 parts of *Salt of Tartar*, and 1 part of *Brimstone*; which being heated in a *Spoon*, flies away with a thundring report. For it seems very probable, that the *Brimstone* and the *Salt of Tartar* contain abundance of the first *Element* in their *Pores*, which makes their parts very much disposed to swim on the said matter, and to fly away as soon as the volatil part of the *Salt-peter* is sufficiently agitated by the heat of the *Candle*, to put them into motion; and as soon as the *Acid Salt of Sulphur* is sufficiently divided, for to penetrate the *Salt of Tartar*.

XIV.
Why this
Powder
makes but
a little
noise, when
it is kind-
led by a
red-hot
Fire.

Experience seems to confirm this, for when we kindle this *Fulminating Powder* with a vehement fire, it makes but very little noise, which probably proceeds from hence; because the *Brimstone* having not had time enough to melt, the *Acid Salts* could not sufficiently divide themselves, in order to their penetrating the parts of the *Salt of Tartar*; which makes the *Salt* to rise with more difficulty, and consequently less able to give a great report.

XV.
In Gold is
hidden a
great vir-
tue against
many Dis-
eases, if we
may be-
lieve the
assertion of
some Physi-
cians.

Gold contains a virtue, proper to cure many *Diseases*. For it is found to afford manifest relief to those that are infected with the *Venerical Distemper*; it cures the *Elephantiasis*, which is supposed to be the same with the modern *Leprosie*: It fastens loose *Teeth*, and heals all *Ulcers* and *Sores* of the Mouth.

But for my part I cannot think that *Gold* can cure any *Diseases* in the *Body of Man*, unless it can be digested in the *Stomach*, or altered by the heat of the *Body*. For the virtue of a *Medicament* consists in this, that the *particles* of it do insinuate themselves into the *Body*, expel the noxious humours, or by their congruity, cherish and corroborate the diseased parts. But how can this be done as long as the *Gold* continues whole and entire, and loseth nothing of its substance? Is it not notorious that the *Leaf Gold* wherewith the *Apothecaries* guild their *Pills*, doth pass through the *Stomach* and *Bowels* untouched, and is cast out whole with the *Excrements*? And yet the said *Leaves* are so very thin, that if the natural heat could exert any efficiency upon *Gold*, it would not fail to do it upon them, by reason of their great tenuity.

Neither is it to any more purpose that *Physicians* do boast of their *Potable Gold*, forasmuch as this is found a meer invention of some *Mountebanks* to pick peoples Pockets. But should we suppose that such a *Potable Gold* might be prepared, yet would it be of no use in *Physick*, because there would be no difference between this *Potable Gold*, and the common *Solid Gold*, but that the one is compact, and the other in a state of solution or fusion.

XVI.
Whether
there be
any Potable
Gold.

But you'll say, that *Corrosive Spirits*, distilled from *Salts*, can dissolve *Gold*, and make it fit for a *Medicinal use*. I do not deny that *Gold* can be dissolved in *Saline Spirits*; but yet I affirm, that this solution cannot be of any use to the *Body* for the cure of *Diseases*, because of the mixture of the said *Corrosive Spirits* which are of a *Deleterious Nature*. And tho' it be common with *Physicians* to order the boiling of pieces of *Gold* in the *Broths* and *Gellies* of their *Patients*, for the strengthening and reviving of them; yet is not this their practice founded upon any sufficient experience, that *Gold* thus used, doth produce this effect; but only upon an inveterate Tradition received amongst them. For seeing that nothing of the substance of *Gold* is communicated to these *Broths* or *Gellies*, it doth not appear how they can be of any use to the *Patient*; so that this custom may very well be reckoned amongst those usages which neither hurt nor help, and are only, as we say, like a *Chip in Pottage*.

XVII.
If Potable
Gold could
be had, it
would be
unprofitable
and dange-
rous to be
given in-
wardly.

Chymists can change *Lead* and *Iron* into *Gold*, of which that famous *Nail* kept in the *Duke of Florence* his *Repository* of *Rarities*, is a pregnant instance, which is so far *Gold*, as it was dipt in a certain liquor by a *German Chymist*.

XVIII.
Whether
Lead or
Iron may
be changed
into Gold.

Tho' all persons that see this *Nail*, generally believe the one part of it to be pure *Gold*, and to have been made such by a *transmutation* of the *Iron* into *Gold*. Yet for my part, I am more apt to be of *TACHENIUS* his Opinion, who supposeth that this part of *Gold* hath been artificially joined to the *Iron* part of the *Nail*, by *Apposition*, without any *Transmutation* at all. For after that this *Artist* had thus joined a piece of *Gold* to the part of an *Iron Nail*, it was easie for him to give to the *Golden part* the Colour of *Iron*, that so the whole *Nail* might appear to be *Iron*: But being afterwards put into the *Fire*, and then held in *Oyl* for sometime, the superadded part appeared to be true *Gold*.

Another thing observable in *Gold* is, that it is not obnoxious to *Rust*; and this because no *steams* proceed from it; and tho' sometimes it seem to be *Tarnish'd*, this doth not proceed from it self, but from the too frequent handling of it.

XIX.
Gold is not
subject to
Rust.

CHAP. V.

Of Silver and Tin.

SILVER doth strangely resist *Fire*, and is hard to melt, because its parts being very small and solid, makes a *Body* so compact and continuous, that the *Fire* cannot easily penetrate it; which is the reason that *Silver Smiths* and others, are obliged to make use of some expedients to make it melt the more readily.

I.
Why Silver
is hard to
melt.

II.
Why Silver
may be beaten
into
thin leaves.

Silver is easily extended under the Hammer, because its parts being long and branchy, they may glide a long while one over another, without breaking asunder.

III.
Why Silver
is of a
white colour.

The reason of the whiteness of Silver is, the solidity of its parts, which reflect the whole light they have received; and with the same action wherewith they have received it. For the particles of Silver being of a Spherical Figure, and having a circular motion, consequently make no change in the Rays of Light; and tho' some of them may be conceived to be rough, yet do they reflect the Rays every way, and send them to the Eye, without any detorsion, or turning of them aside. Yet is not this Colour constant and perpetual to this metal; for when it is polished, it loseth its whiteness, and becomes Bright and Shining; because its white particles do now reflect the Light towards one part, which makes all the other parts to look dark and black, as being hindered to reflect the Beams they have received, to the Eye.

IV.
How it
comes to
pass that
Silver
draws
black lines
upon Paper.

Silver, tho' it be white, yet draws black Lines upon Paper; because by this rubbing of it against the Paper, some small particles of the Silver are rubb'd off; which forasmuch as they are thin and rough, do as it were imbibe or swallow the Beams of Light, and consequently exhibit a Black Colour. But yet they retain something of their former splendor, because some of the greatest particles stick out above the rest; which preserving their former Texture, do reflect the Rays after the same manner as they did before; because being very solid, and consequently very capable of being reduced under an even and polished surface, they resist the Suns Beams; and causing them to be reflected under the same Angles, as they received them, they produce the sensation of Light, for the reasons we have set down at large in our Institution of Philosophy.

V.
Why Silver
yields a
shriller
sound than
Gold.

Silver yields a most shrill sound, and being struck with a Hammer or other Instrument, doth affect the Ears with a more smart and loud noise than Gold.

The reason of this is, because Silver is bent like a Bow, whose parts being left at liberty, do presently return to their former state. For it is evident that the Strings of a Lute yield a shriller or more Treble sound, the higher they are wound up, because it is then they are most swiftly moved, that is, make most frequent Excursions. Whereas Gold being softer, and having fewer pores, doth more easily give way to its being struck, and doth more slowly move the Air. Now the swiftness of the trembling motion, or undulation of the Air, makes a shrill or Treble sound; as the slowness of them, a Base or Deep Sound. And therefore Speaking or Singing makes a greater noise, than a violent Wind, because the Air that strikes the Wind-Pipe, when we are Singing, is much more swiftly moved than the Winds are. Silver therefore gives forth a more shrill sound than Gold, because its bent parts do more swiftly drive the Air, and impart a greater trembling or undulation unto it.

VI.
If Brimstone
be cast upon
Silver that
is melted, it
reduceth it
to powder.

Melted Silver, by casting Brimstone upon it, becomes turned into a Calx, and is reduced into a small Powder.

This Change is brought about by the flaming Brimstone, which enters the pores of the Silver,

and mingles with it, and by this means breaks some of the thinner parts of it, or drives some of them away from the rest, leaving the grosser, and in a manner, the whole substance behind. For by Calcination, the Chymists understand nothing else, but the reducing of the Body of a Metal into Powder, by the ridding of it from its volatile parts only. This being the difference between the Ashes and Calx of a thing, that Ashes are the Remainers of those Bodies, whose greatest part hath been consumed by Fire; but Calx of those Bodies, which do in a manner remain whole and entire after they have been burnt in the Fire.

Silver is readily dissolved in the Spirit of Nitre, or Aqua Fortis, but not in Aqua Regalis, which dissolves Gold.

The Reason is, because the Spirit of Nitre hath such an Analogy with the Pores of the Silver, that it enters the same, only accompanied with the matter of the first Element, by which means the particles of it have all the quickness of that Element communicated to them, and thereby is made fit to unravel the whole Texture of that Metal. And the reason why the Aqua Regalis doth not touch Silver is, because the Pores of the Silver are so small, in comparison of those of Gold, that the Royal Water which enters the body of this latter only surrounded with the first Element, cannot penetrate the Pores of the former.

That the Pores of Silver are lesser than those of Gold, and of all other Metals appears in that the particles of Lead in fusion, do mingle and join themselves more readily with any other Metal than with Silver, which they do only slide over. The same may also be gathered from this Experiment, that when we make the Infernal Stone, which is nothing else but Silver, made corrosive by the Salts of the Spirit of Nitre, we find that one ounce of Plate Silver is only encreased 3 drams in weight; whereas when we employ courser Silver for this Operation, we find the weight augmented no less than 5 drams. Which difference, in all probability, ariseth from hence; for that Plate Silver, being more fire and pure, hath lesser Pores than the courser Silver, which has an alloy of other Metals, and therefore retain more of the acid parts of the Nitre.

Tin, which Chymists look upon as a middle thing between Silver and Lead, hath properties distinct from them both; for Vessels that are tin'd over, are found to resist the Fire better than others, and are not so easily melted.

The Reason is, because Tin, which abounds with Quicksilver, doth easily stop up the Pores and Cavities of Vessels, and therefore hinders the particles of the fire from separating the parts of it so readily, as they would otherwise do. And therefore Chymists commonly call Tin the Defender of Metals, because it preserves them from the force of the Fire; for it enters so deep into the pores of the Metals, that it cannot, without extream heat, be expelled thence. But yet if we touch the Tin with a Red hot Iron, it presently melts; because by this means the particles of the Fire are introduced into the wider pores, which causeth the immediate separation of the parts of it.

Tin is the lightest of all Metals, but when Calcined it is heavier, than when it is whole and entire.

VII.
Spirit of
Nitre easily
dissolves
Silver.

VIII.
The Pores of
Silver are
less than
those of
other Metals.

IX.
A Vessel
that is
tin'd over,
doth more
resist the
Fire than
another
that is not.

X.
Why Cal-
cin'd Tin is
more heavy
than that
is not.

The

The *Lightness* of *Tin* is not to be attributed to the less quantity of *moisture* it contains, in comparison of other *Metals*, as *Silver*, *Copper*, &c. but to the *magnitude* of the *pores*. For seeing that *Tin* is no simple *Body*, but contains many *Heterogeneous Parts*, which cannot so exactly close together, consequently large *intervals* must be left between them, to be filled with the *subtil matter*. Now nothing is more evident, than that the *Lightness* of *Bodies* proceeds from the *magnitude* and multiplicity of their *pores*: And therefore the reason why one *Metal* is lighter than another, is only this, because it hath more and wider *pores*, which set their *parts* at a greater distance from one another. But that *Calcined Tin* should be more heavy than *uncalcined*, seems strange, so much as we find the contrary in other *Bodies*. Thus *Dough* is more heavy than *Baked Bread*, and a *Calcined Stone* is much lighter than another that is not *calcined*: However no other reason can be assigned hereof, but that the *pores* of the *Tin*, by *Calcination*, are more contracted, which is sufficient to make it more heavy, than it was before *Calcination*.

But how comes it to pass, that seeing *Tin* is malleable, yet it may easily be turned to powder, if being melted, it be stirred continually till it be grown cold.

The Reason is, because this continual *motion* separates its parts one from another, in such a manner, as that they can no longer unite themselves together; not only because the *Air*, which is got between them opposeth their union; but also because their small *Branches*, being grown *Cold*, are not pliable enough to entangle one another, and therefore they remain in *Powder*.

A *Tin Bullet*, shot into a *Mans Body*, makes a more dangerous wound than a *Lead Bullet*, tho' they be both of the same bigness, and discharged with the like quantity of *Gunpowder*.

The Reason is, because the outward parts of *Tin* are more rough, and abound with sharp prominences: By this means, as they enter the *Body*, they do much more plentifully affect the *Fibres*, by tearing and rending them to pieces: Or else we may say, that those small *Bits* and *Shavings* as it were, which the *Bullet* leaves in the wound, do infect and taint it; as we see that the *Teeth* of a *Mad Dog*, and of a *Viper*, do poison the wound, which poison soon after is conveyed throughout the whole *Body*, and causeth the *Death* and *Corruption* of it.

CHAP. VI.

Of Lead, and Copper.

L EAD is easily bent, and as readily melted when put upon the *Fire*.

The Reason hereof is, the weak and slender adhesion of its parts; for *Lead* consists of such particles, as are all of them easily separable from one another, and therefore they are no sooner set upon the *fire*, but that they are immediately put into *motion*, and readily separated from one another. For soft *Bodies* differ from *Hard*, in that the parts of the latter touch one another, and are at rest; whereas the parts of *fluid Bodies*, whose Nature soft *Bodies* partake of, are agitated with

various motions, and whirl'd about their own Centers. *Lead* therefore readily melts, because the *fire* with great ease enters the pores of it, dissolves its parts, and varies their Position. Hence some have been of opinion that a *Lead Bullet* might be melted, meerly by a swift motion. But I cannot imagine that this can ever be effected by motion alone; for it was never found that *Lead Bullets* were ever found melted upon their being discharged from a *Musquet*.

Lead doth not differ from *Iron*, save only in this, that it consists of parts that are less, and more smooth, and whose *Branches* are more tender and pliable than those of *Iron*: For because the parts of *Lead* are smoother, therefore they lie more close together, and so compose a more compact *Body*, such as contains more of its own matter than *Iron* doth under an equal surface.

And seeing that the *Branchy Particles* which constitute *Lead*, are more soft and pliant, than those that compose *Iron*, therefore they less resist division, and consequently are not so hard as those of *Iron*.

Lead is endowed with a *Cooling Virtue*, and mitigates the *præternatural Heat* excited in *Mans Body*: Yea some, whose recovery hath been doubted, have been restored to their former health, only by the application of a *Plate of Lead*; as it is related of a certain *Musician*, who wearing a *Lead Plate* upon his *Breast*, only to preserve his *Voice*, was by the same means cured of a most dangerous disease.

The Reason of this *Refrigerating Virtue* in *Lead* is, because its parts are very slowly and remissly moved; and lying upon one another, are in a manner quite at rest. For *Cold* doth not consist in absolute Rest, or a total privation of motion, but it is sufficient to constitute a *Body Cold*, if the parts of it be very slowly moved, and that the *Organ* of him that toucheth it, be more than ordinarily affected therewith. For a *Body*, whose parts are very swiftly moved, is more sensible of *Cold*, than another whose parts are more remissly agitated. A *Plate of Lead* therefore doth cool an overheated *Body*, because it diminisheth the motion of its particles, and doth mitigate and allay the noxious heat, which consists in motion. Hence it is that *Plates of Lead* are applied to the *Reins* of those who are troubled with involuntary Emissions, caused by the heat of their *Reins*. Q A L V U S, the *Orator*, made use of this means to quell and repress the motions of *Lust*, to the end he might preserve all his *Bodily Vigour* and strength, for his *Study*. Chyrurgeons also make use of *Lead*, for the drying and healing of *Wounds*; for by obstructing the pores of the *Body*, by its coldness, it stops the *humour*, and hinders it from spreading any further.

Molten Lead, being stirred with a *Stick* continually, turns into a fine *Powder*.

The Reason is, because by this vehement and continual motion, the more thin and slippery parts of the *Lead*, that kept the grosser parts together, fly away into the *Air*; as we see in *Boiling Water*, which, when it is stirred, doth send forth a thicker *smoak*; for the heat having separated the particles of the *Water*, many of them fly up into the *Air*. And thus the more *Oily particles* of the *Lead*, being left by themselves, do come nearer together,

II.
Why Lead is more heavy than Iron.

III.
Why Lead is less hard than Iron.

IV.
How Lead comes to be useful in Physick and Chyrurgery.

V.
Why Lead, being melted, and stirred with a Stick till it be cold, turns to Powder.

XI.
How Tin may be reduced to Powder.

XII.
Why a Tin Bullet proves more dangerous to the Body than is wounded with it, than a Lead Bullet.

I.
Why Lead is so easily melted.

together, and are joined together more firmly than ever before, much after the same manner, as by the continual beating and concussion of *Cream*, its *superfluous particles* unite together, and constitute the *Body of Butter*, a-part from the *Whey*, wherewith they were mingled before.

VI.
Why Lead cannot be dissolved in Aqua-fortis.

Lead is not dissolved in *Aqua-fortis*, tho' it be left in it never so long.

The Reason is, because the *Particles of Lead* are not proportioned to the *bigness* or *figure* of the *Particles* of that *water*, or *corrosive Spirit*, which therefore cannot penetrate them; or if they do, which indeed seems more probable, they penetrate them accompanied with the matter of the *1st* and *2d Element*, yea, and it may be with the more subtil part of the *Air* also, which makes the motion of them so slow, that they are not strong enough to break the *Ranks* and *Files* of the *Particles* of the *Lead*.

VII.
Why Copper is so hard to be melted except it be kindled with Fire.

Copper is accounted amongst the hard *Metals*, which because of the close connexion of its parts doth long resist the *Fire*, and is not melted except that it be first kindled, and shed so much *Light*, as that it appears like a bright shining *Star* in the *Furnace*.

The Reason hereof is, because the *1st Element* is so shut up in the strait and narrow *Pores* of the *Copper*, that the insensible parts of that *Metal* swim upon it, and are so violently tost together by the said *Element*, and whirled round about their own *Centers*, that they affect the *Optick Nerve* at a distance, and the *Nerves* of the *Touch* nearer hand. However when it is thus melted, it cannot endure any moisture to touch it; for if *water* be pour'd upon it, or any moist *Body* be dipt into it, it causeth a great noise, and the *Copper* leaps out of the *Vessel*. Because the *water* which is heavier than it, doth easily enter its *Pores*, where it becomes dilated because of the intense heat of the *Copper*, and being not able to continue there by reason of the straitness of the place, it breaks forth with violence, and carries the neighbouring *Particles* of the *Copper* along with it, and scatters and spills them: In a manner not much unlike to that whereby *Gunpowder*, that is covered over with little *Stones*, as soon as it is kindled, breaks forth with a noise and scatters all the *Stones* abroad.

VIII.
Whence the Effervescence or Ebullition proceeds which is seen in the dissolution of Copper.

When *Spirit of Nitre* is poured upon *Silver*, it presently causeth a great *Ebullition*, so that it heats the *Vessel*, and continues till the dissolution of the *Metal* be performed.

The cause of this *Effervescence* is, because the *Particles* of the *Spirit of Nitre*, are of such a magnitude and *figure*, that they enter the *Pores* of the *Copper* only, accompanied with the matter of the *1st Element*, which carries them along with it, with so much swiftness, as that they are able to separate the parts of the *Copper*, and to cause that *Ebullition* and *heat* which upon the solution of the parts is produced. Which is an evident proof, that the *Pores* of *Copper* are much more open, than those of any other *Metals*. For this great *Effervescence* which happens upon the dissolution of *Silver* in this *Spirit*, seems probably to proceed from nothing else, but from the largeness of the *Pores* of *Copper*, which are so great that the *acid Particles* of the *Spirit of Nitre*, enter into them surrounded with much of the matter of the *1st Element*.

Copper and *Tin* being melted together grow very hard, beyond what each of them were apart, before they were mingled.

The Reason is, because the *Tin* doth penetrate and fill up the *Pores* of the *Copper*: For certain it is, that *Tin* is a *Metal* of such a penetrating subtilty, that it joyns it self with other *Metals*, after a most peculiar manner; for it penetrates them even before that they be melted together, and by this means hardens them, as may be seen in *Iron*, that is tind over, and *Pins*, which when made red hot in the *Fire*, are dipt into *Tin* for to whiten them, and to bring them to that hardness which we find they have.

Copper easily contracts a *Blewish coloured Rust* which is proper to it, and therefore called in Latin *Ærugo*, which grows to it, and sullies it.

This *Ærugo* or *Copper rust* proceeds from the *Exhalations*, and *Sulphureous Particles*, which continually steam forth from the *Particles* of the *Copper*, and stop the *Orifices* of the *Pores* thereof. It derives its original from the *moisture* of the *Air*, which is mingled with the parts of the *Copper*, which being put into motion by the subtil matter, doth break forth, and being stop'd on the surface of it, doth there grow together into a *Rust*. After the same manner as we see that an *hoary moldiness* doth grow on the outside of *Flesh*, *Leather*, *Bread*, and other like *Bodies*, if they be kept in a moist place, and especially if they be sprinkled with *Salt*, because the *Salt* doth open and widen their *Pores*, and makes an open way for the *Sulphureous Spirits* to evaporate. Hence it is, that clean and smooth *Copper*, doth more easily contract its *Rust*, than that which hath a rough surface; because in smooth and scoured *Copper* the *Pores* are wider, and consequently the moist *Air* doth with more ease insinuate it self into them.

This *Copper-rust* is caused by sprinkling *Salt*, and *Vinegar* upon plates of *Copper*; because both these do open and widen the *Pores* of it, and makes a ready way for the steams to come forth: Moreover, this mixture of *Salt* and *Vinegar* stops the *Particles* of these *Exhalations* on the surface of the *Copper*, and causeth them to grow together there, so as to cover the top of it. And it is for the contrary reason, that *Gold* is not subject to any *Rust*, because no steams proceed from it, so that it is not subject to be sullied or discoloured by any thing that comes from it self.

CHAP. VII.

Of Iron and Steel.

Iron is the hardest of all other *Metals*, as being more difficult to be melted than any of the rest; and yet being put into the *Furnace* and made red hot, it becomes extended in length. For if we take a *Plate* of *Iron* of the same bigness with a piece of *Wood*, and cast it into the *Fire* till it be red hot, we shall find upon the taking of it out, that it is grown longer than it was when we put it in.

The Reason is, because the *Fire* that is got into the *Pores* of the *Iron* doth widen them; for seeing that there can be no penetration of dimensions, and that 2 extended substances cannot be in one and the same place, it cannot be, but that the *Iron* must be

IX.
Why Tin and Copper when melted together become so very hard.

X.
Why Copper contracts a Rust call'd Verdigrise.

XI.
How Copper Rust is caused, and why Gold is not subject to Rust.

I.
How Iron which is so hard a Metal comes to be extended by being made red hot.

be dilated by admission of the fiery Particles, and consequently acquire a new Extensioⁿ.

Tho' Iron be hard to melt, yet it is one of those Metals that are lightest, and are most easily dissolved in corrosive Spirits, and destroyed by Rust; for the small Branches of the parts that compose it, being greater and at a farther distance from one another, than those of the other Metals, make this Metal much more Porous and Spungious, than some of the more compact and solid Metals.

Iron besmeared with Vinegar and Alom becomes like Copper. At Smolnick there is a Well, the water whereof being turn'd in Channels disposed in 3 rows, turns plates of Iron into Copper.

The cause of this Transmutation is not as some would have it, the loss of a former substantial Form, and the generation of a new one, but only an accession of new parts, whilst the Particles of Alom and Vinegar fill the parts of the Iron, and so change the former connexion of its parts. For seeing that Vinegar is of that sharpness, whereby it easily penetrates into the Pores of the Iron, by this its penetration it changeth the order and disposition of them, and by this means a new colour is produced in the Iron. Neither doth the Alom conduce less to this Transmutation, which being endued with a very adstringent Virtue, doth transplace those Particles which before stuck very close together, and were firmly entangled. And therefore it is no wonder, that when the Texture of the parts of Iron is changed, it should by this means come to resemble Copper.

If Red-hot Iron be taken out of a Forge or Furnace, and put into the water, it becomes harder, than when it is only exposed to the Air, and cooled there by degrees.

The reason is, because the Pores of Iron when red hot, are very open, and only filled with the matter of the 1st Element, but mingled with many particles of the 3^d Element, which swimming upon the Fire, do continually enter them, and come out again. Whence it comes to pass, that when, in this state, it is exposed to the Air, to grow cool, the self-same particles of the Air, continuing their course through its pores, cause the pores to be strained by degrees, and make the parts of the Iron to retain the same Form they had in the Furnace. Whereas, when red hot Iron is plunged into Water, it cannot indeed hinder the matter of the 1st Element from breaking out from the pores of the Iron; but because there is nothing that can take up those places, besides the subtil matter which is in the Water, whose particles are too small to keep the pores open in the same manner as they did before, they thereupon become suddenly strained, and consequently come nearer together; which is the cause of its attaining a greater degree of hardness, which is nothing else but a close compression of the parts of a Body, and their mutual contact.

Rust stops the Courses of Women, and given inwardly, hinders Conception.

The Reason is, because Rust consists of Sulphureous, Branchy and Angulous parts, which are very adstringent, and stop up the Orifices of the Pores they light into. As may be seen in the Hands of those that handle it, which cannot without great difficulty be washed clean.

It is found by Experience, that Iron and Steel have abundance of Pores, which are turned and go winding like Screws, and that by means of these, it approacheth to the Loadstone.

The cause of these Screw-like Pores that are in Iron and Steel is, those little Striate Particles, which according to what we have delivered in our Institution of Philosophy, continually coming forth from the inward parts of the Earth, and passing into the outward, have so penetrated the substance of the Iron and Steel, as to make passages for themselves through it, which they will still keep open by continuing their motion through them. Which they could not do, without framing the Pores of the Steel and Iron like so many Screws, which differ nothing from the Screw-like Pores that are in the Loadstone, save only in this, that the little Branches of the Particles of the Iron and Steel, which rise in their Pores, stand in need to be beaten down, and smoothed by the Particles of the Loadstone, for to afford them a free passage.

And therefore Iron is said to be of kin to the Loadstone, because both of them are dug out of the same Mines, and are of the same colour; but more especially, because they agree and correspond in their Fibres and Pores: For the striate matter finds a free passage through both of them, much in the same manner, as it doth through the midst of the Earth, which it cannot do through any other Body. Hence Iron is said to cherish and strengthen the Virtue and Life of the Loadstone, much in the same manner, as the water and virtue of Fountains, is preserved by conveniently disposed Channels for it to pass through.

Steel that is made by fusion in a vehement Fire, becomes softer if it be made red hot again, and afterwards cooled by degrees.

The Reason is, because when it is thus cooled, the cornerd and rugged Particles of it, which by the force of the heat were driven from the surfaces of the Clots of it to the more inward parts, begin to appear outward, and entangling together, do as it were with little Hooks, joyn the Clots of the Steel together: By which means it happens, that these Particles are no longer so closely joyned to their Clots, nor do the Clots any longer so immediately touch one another, but do only hang together as it were by Hooks or Links; and consequently the Steel is not very hard and stiff, nor brittle, but soft and flexible. In which respect it doth not differ from the common Iron, save only in this, that when Steel is made red hot a 2^d time, and afterwards suddenly quenched, its former hardness and stiffness is restored, whereas by the same means, the same is not performed in Iron.

Some Historians tell us, that Wood by being put into some Pools, becomes turned into Iron. Thus MAGINUS tells us of a Pool in Ireland, into which if a Stake be thrust, that part which is covered with the Mud becomes changed into Iron, and the other that is covered with Water, into Stone.

The Reason of this is, because the Wood by being long buried in the Mud, becomes penetrated by a Metallick steam, which insinuating it self betwixt the Fibres of it, becomes one Body with it, and filling up all its Pores by degrees, at last communicates to it the hardness and appearance of Iron.

VI.
How it comes to pass that Iron and Steel have Pores turned like Screws.

VII.
Wherein Iron and the Loadstone do agree.

VIII.
Why Steel becomes softer by being cooled leisurely and by degrees.

IX.
What is the reason that Wood in some Pools is changed into Iron.

X.
How Bones
and Wood
are some-
times
changed
into Stone.

In like manner, *Bones* and pieces of *Wood* are changed into *Stone*. Thus many *Bones* are to be seen at *Rome*, *Amsterdam* and in other places which have been turned into *Stone*. Thus pieces of *Wood* have sometime since been taken up at *Aqua-Sparta* in *Italy*, which seem to be nothing else, but the fragments of *Stakes*, which having for a long time been covered with the *Earth*, have been so penetrated by a *Bituminous* and *Sulphureous Steam*, and grown to that *Stony* hardness, as to be no longer capable of being cleft. Thus likewise *Cockle-shells* are turned into *Stone*, by being fill'd with such a kind of *Petrifying Juice*, which in time reduceth them to the hardness and consistence of *Stones*. For the same *Cockle-shells* that abound on the *Sea-shoar*, have been often found far from the *Sea* on *High Mountains*. Thus in the *Guerriean Cavern* or *Grotto*, *Leaves* of *Oak*, *Helm*, *Alder*, *Poplar*, *Bay*, *Ivy* and other *Trees* have been found turn'd into *stone*, by means of a *Petrifying Humour*.

XI.
Why Steel
is more
stiff and
brittle
than Iron.

Steel is more stiff and hard than *Iron*, and hath a greater force to leap back, than any other *Metal*.

The Reason is, because the parts of *Steel* are not joyn'd together with entangling *Branches*, as those of *Lead* are; but by a multiplicity of *surfaces* lying one upon another like *Glass*, which is the reason that when *Steel* is bent, the ranging of its *Parts* is not changed, but only the figure of its *pores*; upon the change whereof, the force of the *Body* running against them is increased. And by this means the *Steel-Spring* of a *Watch* is of great use to the performing of all the *motions* of it. And for the same Reason, *Steel* must needs be more brittle than *Iron*, because the *Drops* whereof it is composed, are only joyn'd together by the contact of their *surfaces*, which, like the parts of *Glass*, only touch one another in a few *Points*, and must therefore be somewhat *Brittle*.

XII.
How Iron
may be
preserved
from Rust.

For the cleansing of *Iron* from *Rust*, *Ceruss-Plaster*, and other such like, are commonly made use of; but there is nothing that takes it away better or more speedily, than *Oil of Tartar*, which presently looseth the *Rust*, and is then easily wiped off. And to prevent *Iron* from *Rusting*, there is nothing better than to besmear it with the *Marrow* of a *Deer*, or with *Oil*, which by obstructing the *pores* by their clammy Matter, hinder any watry Moisture from entering into, or *Stems* from coming out of them.

CHAP. VIII.

Of the various Generation of Stones.

I.
Stones are
generated
of Sand or
Clay.

ALL *Stones* have their Rise either from *Sand* or *Clay*; and that either from *Sand* dissolved, or *Sand* consolidated.

Stones are generated of dissolved *Sand*, when any quantity thereof becomes coagulated; whence therefore proceeds a *Stone*, transparent like a grain of *Sand*, and of a different figure, as it is variously compressed by its Neighbouring *Bodies*: So some *Precious Stones* are found of no distinct shape or figure, and others that have 6 sides or *surfaces*. Again, *Stones* are generated of consolidated *Sand*, that is, when a great number of the grains of *Sand* do grow together, by

means of *Stems* or *Exhalations* filling the Intervals between them, and joyning them together; and there fore these *Stones* are opaque or dark, and rugged, by means of many *Prominences*, and therefore may be made use of for the sharpening of *Stones*. It may be also added, that *Stones* may be made of *Clay*, which by the admission of some petrifying *Exhalations* may become *Stone*.

There is a sort of *Stones* found in *Provence* in *France*, whereof some are *Red*, and others transparent like *Crystal*, and of the figure of a *Lozenge*, which when they are broken, fall into parts of the same figure, tho' subdivided never so often.

The Reason of this is to be attributed, to the more perfect and elaborate disposition of the Matter whereof these *Stones* are generated, which is so regularly distributed, that every one of its least particles bestow their own figure upon the whole, and upon the lesser, as well as greater parts of it. We must therefore suppose, that in the first formation of these *Stones*, some particles of the petrifying Juice, were by the force of Heat stretched out in length, to which others joyning themselves, did by degrees constitute some small *Tables*, to which others afterwards were joyned, lying athwart them, so that the *Angles* somewhat resembled those of *Talk* or *Izinglass*. As we find that in the formation of *Salts* their basis is of a square figure. Thus the particles of *Sal-Gem* are of a square figure like a *Dice*, and breaks into Bits of the same figure; and after the same manner, and for the same Reason, do these *Stones* before-mentioned break into bits that express the figure of *Lozenges*, and tho' broke never so small, retain the same figure inviolably.

Sometimes *Glassy-stones* are found in the *Earth*, which do equal others in weight, as well as hardness; save only that they are brittle like *Glass*, and are easily broke to pieces.

The Original of these *Stones* must be attributed to *Sand*, which being melted by a most vehement fire, and afterwards cooled, become as hard as *Stone*. After the same manner as the particles of *Asbes*, when agitated by a most vehement fire, have their Ruggedness pared off, and become smooth, and sticking together constitute *Glass*. Thus it sometimes happens, that after great Burnings of the *Earth*, many of these *Glassy-stones* are digg'd forth from the Bowels of it, which are of different shapes and figures, according to the variety of those places into which the melted *Salts* lighted. *PLINY* is of Opinion, that the making of *Glass* was first found out by a Casual melting of *Sand* and *Nitre*: It is reported, saith he, that a Merchant's Ship, laden with *Nitre*, being arrived, when the Ships Company were about to prepare a Feast upon the Shoar, and wanted *Stones* to fix their Kettles upon, they took great lumps of *Salt-Peter* out of the Ship for that purpose, which catching fire, and being mingled with the *Sand* of the shoar, made transparent Rivulets of Liquid *Glass* to run down. Book 36. Chap. 20.

Stones are generated in the Body of Man, differing in bigness as well as hardness: For some of them are easily crumbled to powder, whereas others are hard, and cannot easily be dissolved.

The Original of *Stones*, that are formed in the *Kidneys*, or in the *Bladder*, is the same with those that

II.
Whence is
it that
some
Stones are
found in
Provence
in France,
of the
figure of
a Lozenge,
or Quarry
of Glass.

III.
What is
the Cause
of those
Glassy-
Stones that
are some-
times found
in the
Earth.

IV.
How Stones
are gener-
ated in
the Body
of Man.

that are generated in the *Earth*, viz. when by reason of the obstruction of the *pores*, the *grains* of *Sand* are lockt in, and at last growing together, do constitute a hard *Body*. For it is certain, that the *Blood* and *Urine* are strained, and do carry along with them the *particles* of *Terrestrial Bodies*, which are endued with such *figures*, as that when the *Blood* or *Urine* are more slowly moved in the *Reins* or *Bladder*, they grow into a *Stone*. For the *Sand* or *Gravel* which is generated in the *Body* of *Man*, have very uneven and rough *surfaces*, by means whereof they are easily entangled together, and constitute a mass or lump of *Stone*. And this is the Reason why they are discharged out of the *Body* of *Man* with such extream pain; for being carried with the *Urine*, and hitting against the *Membrans* with their sharp *Corners*, they rend and tear them.

V. Why Women are less troubled with the Stone, than Men.

Women are less troubled with the *Stone* than *Men*, because they can discharge the peccant Matter with greater ease than they, by reason of the wideness of the *Passages* through which it is to pass, as also because they are both straiter and shorter, their *Terms* also being beneficial to them in this case. Moreover it is observed, that *Fat* and *Purisy persons* are most troubled with this *Disease*, because such *Bodies* abound with *Earthy dregs* and *volatile acids*; as also, for that by reason of the bulk and weight of their *Body*, they are fain to live an idle and sedentary *Life*, which alone contributes not a little to the forming of this *Disease*.

VI. Some suppose that Stones are generated in the Body of Man, by a petrifying Spirit.

Some suppose that there is a *Petrifying Spirit* in the *Body* of *Man*, which is the Cause of this generation of *Stones*, more especially in the *pores* of the *Kidneys* and *Bladder*, which transmutes the dreggy and thicker parts of the *Blood* into *Stone*, to which formation that *Volatile Salt*, which is hid in the *Stone*, and drawn thence by *Chimistry*, doth not a little contribute; for by means of these *saline Volatile particles*, the thicker parts of the *Blood* are joyned together. Now that there is such a *Petrifying Spirit* in *Nature*, may be proved from many *Springs*, which turn all the things that are cast into them into *Stone*; such as is that *Spring* which is near *Bergen* in *Norway*, and many others elsewhere. And therefore some think, that the like *spirit* may lye hid in the *Bodies* of *Men*, seeing that it is evident beyond contradiction, that a *spirit* not much unlike this is found in it, which changeth the parts of the *Chyle* into *Bones*, *Gristles*, &c.

VII. Sometimes the Kidneys themselves, yea, and whole Infants in the Womb, have been turned into Stone.

That *Stones* in the *Bodies* of *Men* do sometimes grow to a great bulk, is testified by *ISRAEL*, a *Professour* of *Heidelberg*, who says, that a *Woman* had a *Kidney* cut out of her *Body*, that was wholly turned to *stone*: Yea, what is far more strange, he tells us, that a whole and entire *Birth*, compleat and formed in all his parts, and which the *Mother* had carried in her *Body* no less than 28 years, was after her *Death* found as hard as *Marble*, and taken out of her *Body*. Which wonderful Effect cannot be ascribed to any thing else, but this *Petrifying* or *Volatile acid Spirit*, which is always endued with a great virtue of *acting*, *figuring*, and *congealing*: For the swiftness of this *spirit* doth readily pass through all *pores*, and clinging to them, makes the *Body* to become harder, much like *Coral*, which being taken out of the bottom of the *Sea*, is hardened by the *Volatile Acid* which is lodged in the *Air*, and becomes *stony*.

The *Disease* of the *Stone* is frequently conveyed from *Parents* to their *Children*; for seeing that the *Particles* whereof the *Stone* is formed, owe much of their tendency towards the producing of this *Disease*, to the *Texture* of the *Fibres* through which they are strained; and that the same depends on the first forming of the *Parts* of the *Body*, which proceeds from the *Parents*, this *Disease* may very well be said to be traduced by them to their *Posterity*.

MERSENNUS makes mention of a *Stone*, which being cast into *Fresh-water* lies quiet; but when put into *Vinegar*, or *Spirit of Vitriol*, is moved; and more in *Spirit of Vitriol*, than in *Vinegar*.

The Reason of this may be supposed to be, because this *Stone* is full of *pores*, which do readily admit the *particles* of *Vinegar* and *Spirit of Vitriol*; but are not fitted to receive the *particles* of *Fresh-water*. So that *Particles* of *Vinegar* entering the *pores* of this *Stone*, drive out the *particles* of the *Air* or *Water*, which dilating themselves at their coming forth, do lift up and agitate the same.

Some *Historians* tell us, that there are certain *Quarries* of *Stone* near *Rome*, the *stones* whereof are changed into *wood*.

But I should be much more apt to believe, that these *Stones* are not changed into the substance of *Wood*, but only represent the outward appearance of it. Much in the same manner as that *Vein* of *Stones* which is found at *Novigentum*, on the River *Sein*, do imitate the *figures* of certain *Plants* and *Trees*.

There is a certain *Stone* as white as *Alabaster*, by some called the *Eye of the World*, which being for some time suffer'd to lye in the *water*, doth not only become more *heavy*, but likewise grows transparent, and receives a new *Colour*.

The Reason is, because the *Liquor* that enters into the *pores* of this *Stone*, doth more dilate and diffuse the *Light*, and refracts the *Rays* much in the same manner as the *grains* of *Sand* might do. For it cannot be doubted, but that this *Stone* hath many pellucid *particles*, and that the *Air* which is got into the *pores*, being thrust out by the *particles* of the *water*, make the *stone* to lose its transparency, and to be changed into a *white Colour*; for as soon as the *Stone* is dried, it loseth its *white Colour*, and becomes transparent, as before.

Stones are frequently generated in *Rivers*; yea, it hath been found that the whole bottoms of some *Rivers* have been changed into *stone*. PATRI-TIUS tells us, that whilst he studied at *Avignon*, he frequently went to swim, in the lesser Arm or branch of the River *Rhone*, and that he found that the Bottom, which he had known before to be soft and smooth, was all cover'd with *stone*.

The Cause of this Change might be from the *Earthquake*, which sometime before hapned about the *shut-up Valley*, so called. For the *Earthquake* might probably cast up a great heap of *Sand*, which being conveyed from the River *Sorga* into the lesser Channel of the River *Rhone*, and settling there, might grow into a great multiplicity of *stones*. And this Conjecture seems the more probable; because those who frequent the the River *Rhone* and *Druent*, assure us, that they very often found at the Bottom of them, *Horseshoes*,

VIII. The Stone is often hereditary.

IX. Of a Stone which lies still in Fresh-water; but being put into Vinegar moves up and down.

X. Whether it be true that Stone is turned into Wood, not far from Rome

XI. Of a Stone that being cast into the water, changeth its colour.

XII. How the Stones are produc'd, which are found at the bottom of Rivers.

XIII.
Whence
those Stones
proceed,
which are
found on
the surface
of the
Ground.

shoes, Nails, and other Iron-work, to which the Sands did stick so close, and were grown so thick about them, that they were wholly cover'd with a Crust of Stone, by the coalition or growing together of the said Sands upon the Iron.

Great abundance of Stones are frequently found in Fields, that are in all respects like to those that we meet with at the bottom of Rivers; being of the same bulk and figure, somewhat Oval and inclining to a round figure.

It is probable, that these Stones were carried by the force of waters from the Tops of Mountains to the Fields that lye under them, or else by the overflowing of the Rivers. For it is apparent that the Stones which are scattered up and down the Fields of *Crautia*, come from the overflowings of the Rivers *Rhone* and *Druent*, which left Mud and Sand enough behind them, for the forming of the said Stones. For all the Stones that are found there are not equal, but different in bulk, tho' not in figure: For those that are about the midst are bigger than the rest, and are lessened as they withdraw from it; and those are least of all that are towards the Extreame parts; because the fore-mentioned two Rivers having stagnated there for a good while, more Sand was gathered about the midst, than about the other more remote and outward parts. And that this was the true Cause of the generation of these Stones may be gather'd from hence, that those Plains, which are far remote from any Mountains, are destitute of these Stones, there being not so much as the least footsteps of them to be seen.

XIV.
What is
the cause
of those
Shells that
are found
near Bri-
stol.

In some places not far from the City of Bristol, are found the shells of Fishes of a different colour and form; for some of them are twirl'd about like the Tendrils of a Vine; others, other-
wise.

As to the Original of these, it seems most probable, that they are not the effect of any Juice or Moisture, but were brought thither either by means of an Earthquake, or an Inundation; or by the entrance of some foreign Matter into their pores, which sticking there hath rendred them hard and stony.

XV.
What is
the Cause
of those
Stones
which are
found in
Springs.

Stones are likewise found to be generated in Springs; yea, sometimes the Bottom of them is so full of Stones, that they rise much higher than they were formerly. GASENDUS makes mention of a Fountain of *Dinia*, which covers all the Channels it runs through with a Stony Crust.

The Cause which generates Stones in Springs, is this: The Waters that constitute these Fountains, running through Rocks, do carry some particles of them along to the said Spring; which being no longer swiftly agitated, as they were when they were when they passed through the Rocks, begin to settle and grow together. And that some Waters in their passage through Rocks, are impregnated with Stony particles, may be proved from that Fountain which is at Rome, which hath so covered all the sides of the Pipe that it runs through, that it hath long since been quite stop't with a kind of Alabaster. And the same happens in a Grotto near the City Tours in France, where the Drops of Water dropping down, are turned to Stone.

Wherefore we may conclude with *Peireskian*, that all Stones were not created at the Beginning of the World; but that many are formed in process of time, as owing their original to certain proper Seeds, but their configuration, partly to Nature, and partly to chance. For seeing that a petrifying Seed is found in several places, when the same is received into any Liquor, it immediately coagulates the same, as Renet doth milk, and imparts a special form to it.

Flints are for the most part of a round figure or approaching to it.

The Reason is, because the surface or outward part of the Earth abounding with many Slits, it cannot be, but that the Air which circulates continually in them, must force the parts of Flints, to range themselves into a round figure, because by this means they do less hinder or obstruct its motion.

XVI.
New Stones
are formed
daily.

XVII.
Why flints
are for the
most part
of a round-
ish figure.

CHAP. IX.

Of Pearls and precious Stones.

GEMS and Pearls are commonly called Stones, but with addition of the *Epihet* Precious, because they are highly valued, and not acquired without great labor, or high price. Precious Stones agree with Pearls in this, that they have all the same Figure, and tho' they be the product of several places, yet are never of a different form.

The Reason is, because Pearls are generated in Shells, that are so smooth and polish'd that they shine, which Politenefs the Stones, that are generated in them do partake of. For Pearls in their first rise are a kind of swellings like Warts, or excrescences proceeding from the matter of the said Shells, which in progress of time become Pearls. But Gems owe their generation to certain exactly percolated Juices, which being only in small quantity, every drop of them constitutes a particular Gem, and cannot be encreased to a greater number, but by the occasion of more of these drops. And tho' it may be, they may differ in bulk, yet because the action of the subtil matter is the same in them all, they are all of them partakers of an uniform figure.

Hence it is that all Crystal is 6 cornerd, Emeralds 12 cornerd, Diamants and Rubies 8 cornerd, and so for the rest: Because in their coagulation they are split, and multiplied like the Grains of an Ear of Corn, within the same sheath or hull, and that by reason of their special Seeds, according to which Stones obtain as constant Configurations, as either Plants or Animals. Thus we see that Jaspis Stones, Porphyry and Marble are naturally streak'd and embellish'd with various colours, waved through one another. And a Nutmeg in divers colours, represents the winding turnings of the substance of the Brain. And the same may be observed in the Oak, Walnut and other Trees, which being sawn into Boards, and plain'd, exhibit a pleasing Labyrinth of multifarioufly windings Veins.

Almost all precious Stones do differ in colour, for some of them are perspicuous, others are in a great measure Opaque; neither do those that are Transparent agree in all things. For the Car-
buncle

I.
Why pre-
cious Stones
and Pearls
have the
same figure.

II.
Various
precious
Stones have
various
figures.

III.
Whence the
variety of
colours
that is in
precious
Stones doth
proceed.

buncle is of a Purple Colour, an Emerald Green; a Sapphire Blue, a facincth of a Fiery Yellow, an Amethyst of a Violet Colour, an Opal, various, &c.

Precious Stones are Transparent, when the Steams and Vapours whereof the Juices consist, are not congealed till their slippery and fluid particles be exhaled, so as that the Globuli of the 2d Element can readily pass, and convey the action of Light through them. And on the other hand they become Opaque or Dusky, when the said Steams are stopt in some narrow Crevices of the Earth, and become there so entangled with several Terrestrial Particles, that the Globuli of the 2d Element can have no passage through them. The reason why some Precious Stones are adorned with several Colours, proceeds from the various mixture of Metal-line Particles, which variously reflect the Light, and differently affect our Eyes. This is evident from the mixture of Wine and Water, where the Colours of both are so confounded, that the Water espouteth the Redness of the Wine, and the Wine embraceth the Paleness of the Water.

IV. For we observe that coloured Gems are, for the most part, found in Mineral Veins, or near to them; and sometimes amongst the very Oar of Metals. Thus it is notorious, that Granates are found in the Iron Mines of Norway. And Mr. BOYLE assures us, that Amethysts are drawn out of Iron and Tin Mines. And those who have visited the Copper Mines of Hungary tell us, that besides the Vitriolick Water, which changeth Iron into Copper, there is found another White Water which changeth the remainder into a hard and white Stone: But if before its coagulation it pass through a Copper Mine, then it produceth a Stone called Malochis, of a Blue Colour, which Colour would be Brighter, and of the Tincture of a Turkois, in case this petrifying Juice should happen to pass through a Mine, wherein it meets with any Silver Oar. From all which it appears highly probable, that the Colour of Gems proceeds from the mixture of Metallick Particles.

V. Stains do arise in some Gems, and Spots in others, as in the Agat, &c.

VI. The Reason is, because the juice, whereof they are formed, is gathered together in some receptacles, as it were in a Matrix, and there rests for some time before it is coagulated, by which means, any thing of impurity contain'd in it, doth by degrees sink to the bottom. But if the Juices be congealed before that the Heterogeneous parts be sunk to the bottom, and united into one Mass, the Precious Stones become blemished with several Spots, or Streaks; thus Flies, Pismires and other Insects are found sometimes in Crystal, because falling into the Petrifying Juice, the same was coagulated into a hard lump, before they had time to settle to the bottom. Yea, Historians tell us, that a Serpent has been found in the midst of a Stone, and a live Toad in the midst of another, without the least footstep of any passage through which the Animal might have entred.

VII. From hence we may infer, how fabulous it is what some Authors relate of Amber, that there are some very high Trees in Norway, from whence it distils in the form of a Gum; and that falling down, it becomes hard. Seeing that it is well known, that Amber is dug out of the Earth in Sicily.

Which may be farther confirmed from the Flies and other Insects that are found in it. And whereas abundance of Amber is taken up in the Baltick Sea, we must conclude the same to have been carried thither by the force of the Waves, which often driveth it to the Shoar, where it is frequently found.

Crystal is found in Mountains, especially those which are continually covered with Snow, and where the most intense Cold bears sway.

VIII. The Antients were of opinion, that Crystal was generated of Frost and Snow, or as others, that it was nothing but water, congealed to that degree of Hardness, by extream Cold. And accordingly SENECA expresseth himself thus concerning the Generation of Crystal, The Heavenly Water, that bath little or nothing of Earthly Feculence mixt with it, being once congealed, by the obstinate continuance of Frost, grows still harder and harder; till that all the Air being excluded, it become most closely compressed in it self; so that that which before was Water, is now become a hard Stone. In the 3d Book of his Natural Questions. But we have many Arguments to prove this a mistake. First, Because Crystal doth not melt when it is set to the Fire; neither is any thing diminished by the most intense heat, which yet is the Property of all moisture, that is coagulated by Cold only. Again, if Crystal owes its original to Snow Frozen to such a degree of Hardness, how comes it to pass, that Fire, by a strong Rubbing may be struck out of it? Who ever could strike Fire out of a piece of Ice, as it may be out of Crystal? Lastly, if places abound- ing and covered with Snow, do favour the rise and growth of Crystal, why is it not found in those Mountains where the Snow is perpetual, and where the Cold never suffers intermission?

IX. Conclude we therefore, that Crystal, as well as other Gems, is the effect of a strained petrifying Juice, and that the same derives its difference in Transparency and Hardness, from the diversity of the matter whereof it consists. We have great reason to believe this, because we find that Artificial Crystal is the product of Sand melted by the help of Salts. And tho' sometimes Crystal be found in Rocks, as if it were something produced by them; yet is this only to be ascribed to this Petrifying Juice, which falling into the Chinks of Rocks, becomes there congealed, in the form of falling drops.

X. From what hath been said, we may understand the reason why Precious Stones have a thick and dark ground: For seeing that the clear Liquor whereof they are formed, doth for some time rest in their peculiar Vessel or Womb, it must needs happen, that whatsoever is impure in the said Liquor, must sink to the bottom; and this makes the ground of them more dull and dark than the other parts of them.

XI. Now it is apparent, that not only Crystal but Diamonds and Amethysts derive their original from a Limpid Liquor. But yet we must not imagin, that when they are coagulated, the entire Liquor grows into one Lump or Mass, but that they are all by slits divided into several Stones; and like the many Grains in an ear of Corn are multiplied within the same Sheath; so as that according to the peculiar nature of the Seed, they are

VII. Crystal is frequently found in Mountains.

VIII. The Generation of Crystal is much like that of Sand.

IX. Why the Bottom of Precious Stones is somewhat dusky and dark.

X. Precious Stones are formed of a clear Liquor.

XI.
Whether a
Diamond
cannot be
hurt by
Fire, and
yields only
to the Blood
of a Goat,
by means
whereof it
may be re-
duced to
Powder.

formed into a different Figure, as was mentioned before.

The common or vulgar opinion concerning the Diamond is, that it is of an insuperable Hardness, which doth not in the least yield to any Iron Instrument, Hammer or Anvil: No not to the force of Fire it self; for that being cast into the most violent hot Furnace, it never so much as grows hot; and yet is reduced to powder, by the newly shed hot Blood of a Goat.

These particulars, tho' commonly received, are by experience found to be false; for it is certain that a Diamond yields both to the force of Fire and Iron. Thus BODINUS assures us in his 2d Book of Nature, that a Diamond may with a Hammer be reduced to dust, and ground to powder with an Iron Pestel. The Fire also masters it, for by a continual flame it is reduced to a Calx. Neither is that common report truer than all the rest, that if the Powder of it be taken inwardly, it procures the Bloody Flux, since it is certain, that some Servants, to hide their Stealtb, have swallowed whole Diamonds, and without the least impairing of their Healths, have voided them again. Yea, The Powder of it hath been given inwardly to the quantity of a whole dram, without prejudicing the Health of the Taker, any more than if he had eaten so much Bread. Cardan. 2d Book Tract. 5. Contrad. 9.

XII.
The Elec-
trick Vir-
tue in Dia-
monds is
changeable.

The Electrick Virtue in the Diamond is not always unchangeably one and the same. For Mr. ROYLE hath observed concerning a Diamond of his own, that this Electrick Virtue was frequently changed, being at some times much more strong, than at others.

The Reason is, for that a Diamond, tho' it be a Solid Body, and that its parts do seem very closely compacted, yet are not they altogether free from some inward motions; it being very probable that there are no Bodies so solid, but that their parts are more or less partakers of some motion. Now supposing this intestine motion in Bodies, it cannot seem strange, that upon the changing of the Texture of their parts, their virtue should be changed also. Besides the changes of Colour that are observed in a Diamond, are an evident proof of the motion of its parts; because being rubb'd, it shines and sparkles much more bright and briskly at one time than at another; which change cannot be without motion.

XIII.
What is the
Reason of
the Spark-
ling Bright-
ness of a
Diamond.

A Diamond sparkles the brightest of all other Precious Stones, and strikes the Eye with the most brisk and dazling splendor.

The Reason is, because it consists of a most pure Juice, whose parts are so divided by straining, that they Reflect and Refract the Rays they have received from all sides of them. For all the particles of it are as so many Looking-Glasses, which reverberate the light after the same manner as they receive it. This effect may also be ascribed to the Tincture, whereof it is capable in a high degree, not because of any connate likeness, as some suppose; but because such is the disposition and situation of its parts, that all the strokes of the Tincture do appositely agree together, and take up all the Pores of it; which how much it doth conduce to the Reflexion of the Rays of light, those who are any thing versed in Opticks, cannot be ignorant of.

Mr. BOYLE makes mention of a Turcois, which frequently changed its Colour, and afforded a different representation to the Eye. For after that it had caused a Painter to express most exactly the Colour of it, he found that at other times, it not only appeared to him variously from what it appeared when the Painter took a draft of it, but also perceived several Spots in it, which continually had shifted their places.

All this must certainly be attributed to that Intefine Motion which is in the parts, even of the most solid Bodies. Tho' indeed this motion be imperceptible, and not subject to our Sight. For what other reason can be assigned why the Stones whereof Houses are built, grow harder in process of time, except we allow this motion of their parts, whereby they come closer together? Mr. BOYLE hath also observed the vanishing of a Spot that was in an Agate, and that the Electrical and Radiant Virtue is not always the same in a Diamond, but is at sometimes much more strong and brisk, than at others; which is a sufficient proof, that the parts of the most solid Bodies are not altogether exempt from motion.

Very considerable Physical Virtues are attributed to some Precious Stones, whereby not only outward hurts, but many and great inward Diseases are cured.

It cannot be denied, but that many things which are commonly reported concerning the Virtues of Precious Stones, found little better than Fables. But in case they have any such, which I would not absolutely deny, because it is a thing unanimously attested by many very Learned and Famous Men, they must proceed from some Mineral Juices that are mingled with the matter of the Precious Stones, whilst they are yet fluid. And that such Juices do mingle with them, is evident from hence, because they may sometimes be separated from them, as we see they may in Granates; and for that they frequently encrease the specifick weight of Gems, and endue them with various Tinctures. For seeing that such penetrating Effluvia proceed from the hard Loadstone, and that Precious Stones are endued with an Electrical Virtue, it cannot be questioned, but that many thin and subtil steams do proceed from Precious Stones. Again, what a vast number of Minerals and Metals are there in the Bowels of the Earth, which may be coagulated with petrifying Juices, and unite themselves with the same before their coagulation; and being so united, may exert greater Virtues than are to be found in Minerals that are melted in the Fire, or dissolved in Stigian Waters, and by means whereof Precious Stones may dry, adstringe, consolidate, and produce many other effects.

Coral that grows under the Sea-water, in the manner of a Shrub, and is soft whilst it continues there, as soon as it is brought up into the Air, becomes hard, and loseth its former softness.

Supposing this to be true, the Reason may be, that Coral as long as it lies hid under the Sea-water, doth abound with much Salt; but when taken up thence into the Air, it grows hard and solid by the exhaling of its moisture. For the fluid particles of moisture, that lie lurking in the pores of Bodies, do dilate them, and shake the other parts of them by their motion, which is the proper cause

XIV.
Precious
Stones do
not always
afford the
same ap-
pearance.

XV.
Whether
there be any
Medicinal
Virtue in
Precious
Stones.

XVI.
Why Coral,
which is
soft under
Water,
grows hard
as soon as it
comes to
the Air.



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To Lieutenant Collonell
Wheler of Datchet
Bucks, one of the
first Regiment



Andrew Pitcarne alias
in the County of
Captains of their Ma:
of foot Guards.

This Plate is, humbly

Dedicated by Richard Blome

cause of the softness of those Bodies; but as soon as these fluid particles are evaporated, the remainders are more closely joined together. Thus young and tender Plants, because of the great abundance of Moisture and Salt, which distend their parts, are easily bent or slit, but when they are old, they grow hard, because of the exhalation of their moisture, and the Air entering, instead thereof, are much sooner broken, than bended or slit. Thus PETER PELLEPRAT tells us of a certain kind of Clay, which is found not far from the mouth of the River of the Amazons, which as long as it is covered with the Waves, is soft; but as soon as it toucheth the Air, grows so hard, that the Inhabitant Savages used in former times to make their Hatchets of it.

XVII.
Coral is not soft whilst it is under water.

But when I consider that Coral is of a Mineral Nature, and a kind of Precious Stone, I am more apt to believe, that it is the product of some Glutinous Juice, which being turned into Stone by the binding Virtue of Salt, wherewith it abounds, springs up like a Shrub. For Salt conduceth very much to the encrease of Plants, and is that which causeth them to spread into Sprigs and Branches. And Signior Paulo Boccone witnesseth himself to have experienced as much, who being present, when some were fishing for Coral at Messina in Sicily, he put his Hand into the net before it was drawn out of the water, and found the Coral to be hard.

CHAP. X.

Of the Magnet or Loadstone.

I.
Why a Loadstone points towards the North Pole.

IF a Loadstone be hung up in the Air, or be suffered to swim on the top of Quicksilver, it will wave this way and that way, till one of its Poles look towards the North, and the other towards the South: Yet not altogether in an even Horizontal Situation, but so as that that part which points to the North, will be depressed beneath the Level of the Horizon, to the end it may the better be directed towards the Northern Pole of the Earth.

The Reason of this Conversion must be fetched from the striate matter, whence the Magnet receives all its virtue; the particles whereof are so twisted, that those which proceed from the South Pole, cannot enter in at the opposite Northern Pole; and therefore rushing obliquely into the pores of the Loadstone, swimming in the Quicksilver, they do by the force they have, drive them to continue their motion according to Right Lines. And by this means it comes to pass, that the Magnet, after some motions this and that way, returns to its natural state. So that being left to its liberty, the South Pole of the Magnet tends to the North Pole of the Earth, and the North to the South; because the striate matter, which passeth from the North Pole of the Earth, and takes its course through the Air, towards the South, comes first from the South part of Heaven, through the midst of the Earth; as that comes from the Northern part of the Earth, which returns to the North. Furthermore the reason why the Loadstone doth not keep it self in an Horizontal Situation, but declines towards the North Pole is, because we live

in the North part of the World, and consequently have the North Pole nearer our Horizon, than the South.

Wherefore if you apply the North Pole of a Loadstone you hold in your hand, to the North Pole of another swimming on Quicksilver, or water with the help of a Cork; this latter will withdraw from the Loadstone you hold in your hand, because the striate matter that proceeds from it, in taking its compass, doth hinder the other. But when this latter Loadstone turns its South Pole to that which is immoveable in your hand, then it will approach to it; because the interposing Air being driven away by the striate matter, the Loadstone, by how much the less resistance it finds, is the more forcibly driven on by the Air that doth surround it.

II.
Why one Loadstone approacheth to another, or withdraws from it.

Now that the Magnetick matter doth make a kind of Vortex about every Loadstone, may be evinced by several Arguments. We find that the Needle of a Compass, is put into various situations, according as it is differently posited about the Loadstone: being placed even with the Poles of the Loadstone, it lies in a straight line, and makes one Line with the Axis of the Loadstone; but is variously inclined when it is otherwise placed. Another experiment that makes out this, is, that if you pour out the filings of Steel upon Paper, having a Loadstone fitly placed in the midst of it, we shall find in the said filings the plain draught and appearance of a Vortex. For upon the shaking of the Paper, we shall with pleasure behold the filings of Steel ranging themselves, as it were, into certain Rings, whereof those are the largest which shall return to those parts that are nearer to the Poles. And if afterwards another Magnet be laid near to the former, then those Rings of the Vortex will appear under another Figure, to the end they may pass now through the Poles of this last placed Loadstone, in case that care be taken, that the South Pole of the one of these Magnets, be turned towards the North Pole of the other. Which Experiments demonstrate to the Eye, the various Rings and turnings the magnetical matter makes about every Loadstone.

III.
Arguments proving that there is a Vortex of the Magnetick Matter.

When a Loadstone is divided in length, its Poles by this means are changed, and those parts of the Fragments or Pieces, which before this Division were join'd together, and pointed to the same Poles, do now withdraw and flee from one another. For if the Parts A and a were before join'd together, and so likewise B and b at the other end; as soon as this division is made, a will turn to B, and b towards A; so that the North Pole of the one doth no longer agree with the North Pole of the other; nor the South with the South Pole.

IV.
When a Loadstone is divided, its Poles are changed.

The Reason is, because the Southern striate Particles, which come forth through the Northern Part of one Section, must enter into the other through the Southern Part, and come forth through the North. Forasmuch therefore as the striate Particles, which come forth from the greater Fragment A B, are Southern, they must turn about the upper piece a b, and so fit and dispose the same, as that they may freely enter through a, and go out again through B. For A is supposed to be the South Pole, by which the Southern Particles do enter, that come forth from the other part of the Segment or Division through b, and which there-

Figure 21.

fore cannot enter through *b* into the upper part of the *Loadstone*, because it is *Northern*, and therefore unfit to admit the *Northern striate matter*.

V.
How a
Knife that
hath ac-
quired a
Magnetick
Virtue, by
being rub-
bed on a
Loadstone,
comes to be
deprived of
its Virtue.

A *Knife* that hath been rubb'd with a *Loadstone*, attracts *Iron* after the same manner as the *Magnet* it self doth; but if we pass it over the *Pole* of the *Loadstone*, a quite contrary way, than we passed it at first, it will lose the *virtue* of drawing *Iron*, which by the former rubbing or passing of it over the *Loadstone* it had acquired.

The Reason hereof is, because the *Knife* by being passed over the *Loadstone*, or rubb'd against it, was become a perfect *Loadstone*, for this reason only, because the *magnetical matter* had opened its *Pores*, and had smoothed those prominent little *Branches* of the *metallick particles* in the said pores that before hindred their free and ready passage through them. And so in like manner it loseth the *quality* of a Perfect *Loadstone*, by being passed in a quite contrary way over the same *Pole* of the *Loadstone*; because the *magnetical matter*, exerts now a contrary effect upon the *Knife* to what it did before, that is, it now raiseth again the prominent extremities of the *Branchy Particles* in the *Pores* of the *Knife*, which it had before couched, and smoothed.

Now that this is so, appears evidently from this Experiment, that if we lay some filings of *Steel* upon a *Paper*, as was before-mentioned, and draw or pass a *Loadstone* over them, we shall see that the parts of the said filings will range themselves one upon the top of another, and constitute, as it were, so many *Hairs*, which all of them lie one way; and if then we pass the *Loadstone* over them the contrary way, we shall find the said *Hairs* to turn themselves, and to lay themselves a quite contrary way to what they were before.

VI.
What is the
Cause of the
Declination
on that is
found in
the Magnet.

The *Poles* of the *Loadstone* do not always point directly to the *Poles* of the *World*, but variously decline from the same, as may be seen in Dr. GILBERTS Treatise of the *Loadstone*, who gives us an account of the observation of one Mr. BORROUGHS, who in the year 1580 at *Limcboufe* near *London*, observed that the *Declination* of the *Loadstone* was 13 degrees and 35 minutes: And of Mr. GUNTER, who in the year 1622 found the said *Declination* to be only of 6 degrees, and 13 minutes: And last of all his own observation, who in the year 1634, found it to be only of 4 degrees and 2 minutes.

The decrease of these *Declinations*, proceeds from the *Earths inequalities*. For it is certain that some places abound with *Iron Mines* more than others, and that the *Loadstone* is not equally differt in all places; but is found much more plentiful in one than another. And therefore it is that the *striate particles*, which find a more free passage through the *Magnetical Bodies* than through any other, breaking forth from the inward part of the *Earth*, do flow in more abundance towards some places, than towards others: And by this means do frequently deviate from their course, and turn aside towards other *Bodies*, through which they pass more easily and readily. And forasmuch as the turning of the *Poles* of the *Magnet*, or of the *Points* of the *Needle*, doth only depend on the course of those *Particles*, it must needs point that way where there is a greater

quantity of *matter*, that is proper to draw it. This is evident in any *Loadstone* that is not of a *Round* or *Spherical Figure*: For if a small *Needle* be applied to the different parts of it, it will not always turn it self to the *Poles* of it in one and the same manner, but will frequently decline a little from them. And therefore it cannot seem strange to us, if the *Declination* of the *Loadstone* be changed in one and the same place; and that in process of time its *Poles* do not exactly point to the *Poles* of the *Earth*; Because this *matter* may shift its place; as for instance, in the bottom of the *Sea*, or in the cavities of the *Earth*; or the *Iron* may be dug out of the *Earth* in some parts, or be corrupted, and degenerate into another *Body*.

Hence it appears, with how little reason some *Philosophers* do endeavour to explain the *Declination* of the *Magnet*, by the *Deviation* of the *Little Bear*, or of the *Poles* of the *Ecliptick*, from the *Pole* of the *World*: Seeing that there be many places found, where this *Declination* is towards the *West*, as it is generally on the *Eastern* side of the *North* part of *America*; on the *Western Coast* of *Nova Zembla*; on the *Eastern Shoar* of *Africa*, and the *Western* of *Goa*. Yea, in the *Azores* Islands, which lie betwixt *Europe* to the *East*, and *America* to the *West*, it declines neither way: As in *Trinity Isle*, at the *Promontory* of *Needles*, near to the *Promontory* or *Cape* of *Good Hope*, at *Vienna* in *Austria*, and other places.

Some tell us that a *Spherical Loadstone* being placed upright on one of its *Poles*, hath less *declination*, than when its *Poles* are at an equal distance from the *Earth*.

The Reason of this may be, because the *striate particles* that are in the upper part of this *Earth*, do not only turn from one *Pole* to the other, by *Lines* that are at an equal distance from its center; but also because every where (the *Equator* only excepted) some of the said *particles* do ascend from its inward parts, the turning of the *Magnet* set upright on its *Poles*, depending on these latter *particles*, but its *declination* chiefly on the former.

The *Loadstone* communicates its *virtue* to *Iron*, and doth so change it with a *Touch*, as to make it point towards the *Poles* of the *World*, in the same manner as it self doth. The famous GASENDUS observes, that the *Iron Cross*, which had been fixt a long time on the top of the Great Church of *Aix*, being cast down by a *Storm*, did acquire a *Magnetick Virtue* from the *Earth*, so as that the parts of it did attract *Iron Nails*, and turn themselves towards the *Poles* of the *World*. So likewise it is observed, that when a *Rod* of *Iron* has toucht the *Earth*, the lower part of the *Rod* draws the point of the *Needle* of a *Compass* that points to the *South*, to it self.

This happens because of the great affinity there is between the *Loadstone* and *Iron*: for they are so much alike, that the *Loadstone* may be called *Raw* and *Undigested Iron*; and *Iron* the *Riper* and more *Pure* part of the *Loadstone*. For *Iron* is melted out of the *Loadstone*, as out of its proper *Vein*. Hence it is, that in *England*, *Germany*, *Italy*, and other places where *Iron* is found, the *Loadstone* is found also, as proceeding both of them from the same *Matrix*. But as for the manner how

VII.
Magnetic
Bodies are
not always
turned from South
to North.

VIII.
If the
Loadstone
be placed
upright on
one of its
Poles.

IX.
Iron, being
toucht by
a Loadstone,
acquires a
Magnetick
Virtue.

Iron

Iron is made partaker of the *Virtue* of the *Magnet*, and by touching it, doth acquire the same *Inclination*: This we shall understand if we suppose that *Iron* is endued with fit *pores* to receive the *striate matter*, and that it wants nothing towards the obtaining of this *Magnetick Virtue*; but only that some little *branchy particles* sticking out in the *pores* of it, which do make them somewhat rough and uneven, must be bended one way for the easie passage thereof. Now upon the application of a *Loadstone* to *Iron*, the *striate matter* which continually takes a round from one *Pole* of the *Earth* to another, with vehement force and in great quantity, rushing like a *Torrent* into the *Pores* of the *Iron*, doth bend these prominent extremities of the *branchy particles* all one way; and therefore effects whatsoever is necessary to the making of it fit partaker of this *Magnetical Virtue*.

X. Why Steel is more proper and fit to admit this Magnetick Virtue than Iron.
Hence it is that *Steel* is more proper to receive this *Magnetick Force* than *Iron*, because it hath more, and more accurately framed *Pores* for the reception of these *striate particles*. And doth also preserve the said *Virtue* longer, because the prominences of the extremities of these *branchy particles* that are in the *Pores* of the *Earth*, are less flexible, and therefore cannot so easily be bent the contrary way.

XI. How Steel Scissars may be made partakers of a Magnetick Virtue.
The Famous *Mathematician* Mr. BUOT hath found by experience, that *Steel Scissars* or *Penknives* having been heated in a *Forge* till they be of a *Red Colour*, and then suddenly extinguish in cold water, and afterwards neal'd in the fire again, till they be of a *Blue* or *Purple Colour*, and then whetted and made bright on a *Whetstone*, if presently after they be made to cut, or pierce through *Plates* of *Iron* or *Steel*, by this means a *Magnetick Virtue* will be communicated to them, so as to attract *Iron Nails*. Of which no other reason can be assigned, but this, because the *Pores* are so disposed in *Steel* prepared after this manner, that the *Heavenly matter* can with more ease have *Egrefs* and *Regrefs* through them: So as that no out-flowing *particles* from the *Magnet* do remain, but doth only afford a free passage to the *External matter*.

XII. Why an Armed Loadstone doth attract stronger than one that is Unarmed.
The *Armed Loadstone* A, doth bear up more *Iron* B and C, than another that is not: For *GALLILEUS* hath observed, that a piece of *Loadstone* weighing 6 ounces, will scarcely bear 2 ounces unarmed; whereas the same *Loadstone* armed will bear up 160 ounces; so as that it attracts 8 times more than when it is unarmed, and a weight 25 times greater than its own weight.

Figure 22.
The cause of this increase of the attractive *Virtue* is, because the *Iron* D E, wherewith the *Magnet* A is armed, is endued with *Magnetical Parts*, that are purged from *Terrestrial Filth*, and *Heterogeneous Impurities*; for which reason its *Pores* do most fitly correspond and agree with the *Pores* of the *Iron* that hangs at it B and C, and by this means the *striate particles* that pass through these *Pores* from the one *Iron* into the other, do drive away all the *intermediate air*; and makes their surfaces to touch one another immediately; by which means they cannot, without great difficulty, be separated; and therefore the weight B, or C, doth stick more strongly to the *Iron* D E. For nothing can be more proper to join 2 Bodies together, than immediate contact.

A *Loadstone*, being thoroughly heated, loseth its force of drawing of *Iron*, and doth no longer turn towards the *Poles* of the *World*. For if you heap live Coals about a *Loadstone*, you will see a *Blue Sulphurous Flame* to break forth from it; upon the dissipation of which you will judge it to have lost its attractive *Virtue*.

The Cause of this Loss of the *Magnetical Virtue* is, for that the *Fire* entering into the *Pores* of the *Magnet*, many of its thin and slippery parts are driven away; upon the removal whereof, a new texture of *Parts* is produced in the *Magnet*. As we see that a *Stick* being put into the *Fire*, becomes crooked by degrees; because the force of *Heat* brings some of its parts closer together, and at the same time separates others of them. The *Fire* therefore having thus changed and confounded the former situation of the *particles* of the *Loadstone*, the *striate matter* which was used to pass through them, finding the *Pores* much wider than they were before, doth exert but a very small force, or rather none at all upon them.

Tho' there be many great *Philosophers*, who deny that a heated *Magnet* can ever recover its lost *Virtue* again; yet the contrary hath been found by experience. Some indeed have observed, that a *Magnet* that hath been made red hot, is by this means robb'd of the greatest part of its *Virtue*, and changeth its *Poles* in case it be placed to cool in an inverted situation towards the *North*. Or if when it is a cooling, the situation of it be frequently changed from one position to another that is opposit, it will wholly change its *Poles*; so as that that which was before the *North Pole*, will become the *South*, notwithstanding that the *Loadstone* be then placed perpendicularly upon the *Horizon*.

Thus those *Glass-Drops*, which upon the breaking off of their *Points* become shattered into the smallest *Dust*, being by degrees put to the fire, do lose their *Elastick virtue*.

The Reason is, because the *Parts* which before were stretched, are made wider by the admission of *Heat*, and by degrees sit looser from one another; and thus the *Texture* of the *parts* being changed, they are now no longer like *Sticks*, with *Wreaths* twisted hard about them, and therefore do not so strongly resist the force of the *Hammer*, and become wholly deprived of their *Elastick virtue*.

But if a Piece of *Iron* be applied to the *Pole* of a *Magnet* from the Right to the Left, it presently loseth the *virtue* it had before acquired; because the parts of the *Magnet* are changed, by this contrary passage of the *subtil matter* through them, and the *pores* differently ranged and formed from what they were before. And on the contrary, it hath been frequently found by Experience, that the *Iron bars* of *Windows* looking towards the *North* or *South*, do retain a perpetual *Magnetick virtue*: Because the *striate Matter* that proceeds from the said *Poles*, by process of time, do hollow *pores* for themselves through the said *Iron-bars*.

A *Plate* of *Iron*, which we have said before, being joyned to the *Pole* of the *Loadstone*, doth increase its force to bear *Iron*, doth hinder the *virtue* it hath of turning *Iron* towards it. For the *Iron-Plate* D C D, doth hinder the *Loadstone*

XIII. A Loadstone thoroughly heated loseth its force to draw Iron.

XIV. A Magnet that hath been heated, may recover its lost Virtue again.

XV. Glass drops when put to the Fire, lose their Elastick Virtue.

XVI. A Loadstone upon the changing of its Poles, doth lose its Virtue also.

XVII. How a Magnet may be some time hindered from drawing the Iron.

Figure 45.
in the In-
stitution.

A B, to whose Pole it is joyned, from drawing the Needle E F towards it.

The Reason is, because the *striate Particles* that proceed from the *Loadstone*, do rather pass through *Iron*, than any other *Body*; and therefore the said *particles* are diverted by the *Iron-Plate*, from passing through the *Air* to E F. And certainly, besides the *Iron* or *Magnet*, no other *Body* can be substituted in place of the *Iron-plate* C D, by which the *Loadstone* A B is hindred from exerting its force upon the *Needle* E F; as hath been said in the *Institution of Philosophy*.

XVIII.
Whether
there be
any thing
of Truth
in the story
of Maho-
met's Tomb.

There is a Common Story goes of MAHOMET's Tomb, that it is pois'd in the midst of the *Air*, between 2 *Loadstones*, without touching either the top or the bottom of the *Temple* at *Meccha*.

I take this to be a meer *Fable*: For it is beyond the power or wit of *Man*, to get 2 or more *Magnets* that are altogether of the very same force and virtue; and if these could be got, yet would it still be as impracticable, or rather impossible to place them so, as that the *Iron* placed between them, should not be drawn in one part of it more than in the other: Seeing that a very small and inconsiderable difference in the *Loadstone*, *Iron*, or in the place it self, would be sufficient to overthrow that Equality. Neither are we to ascribe any greater Authority to the *Stories* that some *Authors* tell us of the *Horse of Bellerophon*, and of the *Statue* that was in the *Temple of Serapis*. These being nothing else but pure invented *Stories*, which have gained Authority by the *Credulity* of the *Vulgar*.

The Sixth Part

OF THE

H I S T O R Y

O F

N A T U R E.

O F

M E T E O R S.

CHAP. I.

Of Vapours and Exhalations.

I.
Why Va-
pours are
more copi-
ous in Win-
ter, than
in Summer.

MORE Vapours do seem to arise from the *Earth* in the *Winter*, than in the *Summer*, when the *Sun* with more direct *Beams* beats against the *Earth*, and more strongly agitates the fluid *particles* of *Pools* and *Rivers*. Hence it is that we have then greater store of *Rain*, and that the *Air* is more darkned with *Mists* and *Clouds*.

This is the *sentiment* of the *Common People*, who judge of the *Oeconomy* of *Nature*, only by the outward *Senses*, and without examining, embrace whatsoever they offer first. But Reason will persuade us to be of another opinion: For the *Sun*, who, by his presence, raiseth *Vapours* and *Exhalations* into the *Air*, doth in *Summer* display his heat more upon *Pools*, and moist and boggy places, than in *Winter*; when his *Beams* do only obliquely or slantingly strike against the *Earth*; and consequently at that time produce a weaker agitation in the *waters*. Moreover, we find that the *waters* in *Summer* do signally decrease. Wherefore the true reason why *Vapours* are in

greater abundance in *Winter* is, because the *Air* being then *Cold* by reason of the *Sun's* absence, the *Vapours* cannot mount up to any considerable height in the *Air*, but are presently condensed, and so becoming heavy, fall down again to the *Earth*.

It is observed that *Exhalations* proceed more copiously from some parts of the *Earth* than from others; not only from those which are covered with thick and close *Woods*, but even in those which are equally enlightened by the *Sun*.

The Reason of this may be, some *subterraneous Fires*, which by putting the moisture that is shut up in the *Earth* into motion, do, through various passages, transmit and disperse it. For it is not to be questioned, but that there are *Fires* hidden in many parts of the *Earth*; which meeting with matter fit to be turn'd into *Steams* or *Exhalations*, do drive the same upwards. As we find that *Gardens* that are kept in good order, and *Ploughed Ground* do send forth more *effluvia* than other places, especially if they be much exposed to the heat of the *Sun*.

Vapours and *Exhalations* do not mount up to any considerable height in the *Air*, but there stop at different distances from the *Earth*.

II.
Why more
Exhalations
do arise
from one
part of the
Earth, than
from another.

III.
Vapours
and Exha-
lations stop
in the Air
at a cer-
tain di-
stance from
the Earth.

The

The *Lower Region* of the *Air* is hotter than the *Middle*, and the *Middle* hotter than the *Highest*, not only because they are nearer the *subterraneous Fires*, and those *fermentations*, which are excited in the more outward parts of the *Earth*; but also by reason of the *Reflexion* of the *Suns Beams*, which is the chief cause why the *heat* of this *Star* is greater in those *Regions*. Now this supposed, it is evident that the *Vapours*, being lighter, may ascend to the highest *Region* of the *Air*, whilst the *Exhalations* can scarcely get up to the middle, where most of the *Meteors* are forged and produced; and this by reason of the great variety of *degrees of Cold and Heat*, which by turns do there bear sway.

IV.
Why Water, when turned into a Vapour, doth take up more place than it did before.

Water, when it is turned into *Vapour*, takes up much more room than before; forasmuch as the parts whereof the *Vapour* consists, because of their swift agitation, do spread themselves every way, and are swiftly whirl'd about, and thereby extend more in length; so that by this means every one of them are of force enough to drive away any neighbouring parts that would make an irruption into the *Rings*, which by their *circulation* they describe. Much in the same manner, as when the Stick *L M*, through which the piece of Cord *N P*, is put, being violently turn'd round, the Cord, by this means, is extended at its full length, and fills up the whole space of the Circle *N O P Q*, so that no other *Body* can enter the said space, but that the Cord, in this its motion, would drive it away.

Figure 23.

V.
Rarefied Air doth not turn to Fire, as Aristotle held.

This shews *ARISTOTLES* mistake, who was of opinion, that the *Air* may be so dilated, as to change its nature, and to take upon it the form of *Fire*: For it is found by experience, that if the *Bladder* of a *Pike* be prickt with a *Pin*, and all the *Air* let out, and then it be so closely tied up again, that no *Air* can enter into it; if afterwards the said *Bladder* be put into a *Glass Pipe*, having a broad Bottom, and a wide Mouth, being tied close about with a *Hogs Bladder*, and *Quick-silver* put into it, it will display it self, and swell into the same dimensions, as it was when first it came out of the *Fish*, tho' the *Air* in the *Bladder* be above an 100 fold rarefied above what it was before, by the agitation of the subtil matter contained in it.

VI.
Why the Steam of a Mans Breath is condensed into water against Glass Windows.

The *Steam* proceeding out of a *Mans Mouth*, in cold weather, is condensed on the Panes of a *Glass Window*, into drops of *Water* or *Ice*.

The Reason is, because the *Vapours* by the heat of the *Stomach*, are carried to the *Windows*, and being not able, because of their thickness, to pass through them, become there condensed into *Water*; and if the Weather be very cold and frosty, they turn to *Ice*, and represent several figures on the *Glass*.

VII.
Why some Bodies send forth healthful, and others hurtful Exhalations.

The *Steams* that proceed from *Bodies*, are distinguished by their *smell*; for some are good and healthful, others evil and hurtful. In places where abundance of *Roses* grow, the whole neighbouring *Air* is filled with a sweet *Rosie Odour*: Whereas on the contrary, in places where *Dug* or *Carion* is cast forth, the *Air* is annoyed with abominable and noxious *Vapours*, and stinking *Smells*.

The Reason is, because these *Effluvia* which wander through the *Air*, are nothing else but lively and active particles of *Earthly Bodies*; which

being agitated by the *heat* of the *Sun*, are carried upwards, in the very same manner as we see that a wet *Cloth*, hung before the *Fire*, doth send forth vaporous *Steams*. Wherefore all manner of *Exhalations*, are either *healthy* or *hurtful*, according as the *Bodies* from whence they proceed, are either sound, or tending to *putrefaction*. Thus we find that the *Vapours* which arise out of the *Earth* are dry, because they consist of dry *terrestrial particles*: Whereas those that are sublimed from the *Sea*, are moist and cold; because they consist of fluid and slippery *Aqueous particles*, which running together, constitute a liquid and cold *Body*.

Accordingly we find that observation to be very true which *Sir KENELM DIGBY* makes of *London*, in his *Treatise* of the *Sympathetical Powder*, viz. that in the *Winter* especially, the *Air* is filled with *Soot* and *volatil Salt*, from the *Smiths Coals* that are generally there burnt, which flying in the *Air*, enter the closest shut Rooms, Trunks and Chests; sullies and spoils the *Furniture* of *Beds* and *Hangings*. And it is not without reason, that *Physicians* attribute to this cause, that so many are troubled with, and die of *Consumptions* of the *Lungs*; because the *Air* abounding with such particles, is very apt to inflame and ulcerate the *Lungs*.

From what hath been said, we may easily see the reason why *Steams* are the cause of the infection of the *Air*, and of the corruption of the *Bodies* of *Animals*. For as the particles of *Rennet* being dispersed through the substance of *Milk*, do change the situation of its parts, and make that which before was liquid, a fixed and hard *Body*: So likewise the particles of *pestilential Steams*, penetrating the pores of the *Air*, do pervert and overthrow the *Texture* of its parts, and cause malignant *Distempers*.

And accordingly it is most certain, that innumerable *Diseases* are caused from *poisonous Steams*. And forasmuch as these *Fumes* do commonly proceed from *Mineral Juices*, therefore the destruction that is caused by them is so much the greater, as abounding with sharp and corrosive particles, which are the fruitful seeds of many malignant *Distempers*, and are very noxious to the vital *Spirits*. Thus we find that in several places such *poisonous Exhalations* break forth out of the ground; as at *Puteoli*, where there is a *Pool* or *Lake* which sends forth sulphureous *Steams* that are pernicious to the very *Birds* that fly over it. In like manner there are many places in *Campania*, where abundance of sulphureous and bituminous *Exhalations* proceed from some *subterranean Cavities*, some whereof are healthful, and others hurtful.

To these *Exhalations* and *Steams*, now mentioned, may be added that subtil *Steam* or *Breeze*, which being sublimed from the *Earth* in the day time, and falling down again after *Sun set*, is call'd the cool evening *Air*, and found to be hurtful to many, especially to those who are of a less compact frame of *Body*, and whose pores are more open. This *Steam* is also wont to be more hurtful about the time of the *Aequinoxes*, especially in places that abound with *Mineral Exhalations*. For a moderate heat raiseth a vast number of *Vapours*, especially in moist and morish places; which *steams*, because they abound with sharp and cor-

VIII.
Why some men die in London of the Consumption.

IX.
Why some Steams are noxious to the Body.

X.
Exhalations are the cause of innumerable distempers.

XI.
The Evening Air is found to be hurtful to many.

rosive particles, enter through the pores into the Head, and cause Tooth-ach, and many defluxions; as also by their sharpness, opening the Capillary Veins, they occasion great bleeding and watchings, and are in a particular manner noxious to the instruments of Respiration.

XII.
Exhalations are not so easily carried upwards as Vapours.

Vapours are more easily carried upwards than Exhalations, as may be seen in the distillation of common Salt, Nitre and Vitriol, whose Exhalations do not rise without a great force of Fire.

The Reason is, because the water which furnisheth the matter of Vapours, consists of long smooth and slippery parts, figured somewhat like Eels; which tho' they be entangled together, yet are never so closely joined, but that they may be easily separated from one another. Whereas the Earth, whence Exhalations do arise, consists of more irregular parts, which, like Sprigs, grow close together in Hedges, are easily twisted together, and cannot without difficulty be separated again. Wherefore Vapours that consist of the thin and slippery parts of the water do more readily mount up than Exhalations; which because of the closer texture of their parts are kept down, and cannot ascend, except they be born up by other Bodies.

XIII.
Why our Breath feels more hot when breathed with an open Mouth, than when our Mouth is drawn together.

A hotter Steam or Breath proceeds from an open Mouth, than from one half shut.

The Reason is, because heat consists in the agitation of the little particles of the terrestrial Bodies; wherefore when we blow strongly against our Fingers, close joined together, we find that our Breath feels cold in the outward surface of our Hand; because being carried there most swiftly, and with equal force, doth not produce any considerable agitation; whereas on the contrary we perceive it to be considerably hot betwixt our Fingers, because being more slowly and unevenly moved betwixt them, it puts their small parts into a greater motion. And it is for the same reason that we feel that breath hot, which is breathed from our open Mouths, whereas that which is blown from them when almost shut, seems cold to us. As we find that commonly violent Winds are cold, and the gentle are commonly the hottest.

XIV.
Why we can see our Breath in the Winter, and not in the Summer.

The Breath of Animals is visible in Winter, as also the Steams that proceed from them in sweating; but not in the Summer.

The Reason is, because the particles of the Vapours, which in Summer are carried through the Air, do more comply with the motions of the subtil matter, and give way to all its impulses. But in the Winter, when the subtil matter is more weakly agitated, the breath is condensed by the coldness of the Air, and is frequently turned into water; and in extrem cold and frosty weather doth turn to Isicles on the Hair of Mens Heads and Beards. Whereas in the Summer they are not perceived at all, because of the heat of the Air, which disperseth them far and near.

XV.
Steams proceed from all Bodies.

Wherefore it cannot be questioned, but that the most solid Bodies do send forth some Steams or Effluvia from them, which compose a kind of Atmosphere about them. As is evident, not only in Amber, Camphire, Spanish-wax, and the like, which diffuse their Odour through the Ambient Air; but also in Wooden Vessels, which being exactly weighed, will be found to have lost something of their weight: And in Eggs, whose sub-

stance evaporates, even in the coldest season; yea and in Ice it self, which being exposed to the Air in the Night, doth decrease in heaviness, and is considerably diminish'd as to its substance. And if in some Bodies, such an efflux of particles be not perceived, the reason hereof probably may be, because we have no Scales exact to discover the same, seeing that the Scales and Weights themselves are subject to this decrease by a continual efflux of particles, and are not always the same weight.

But these Effluvia are no where more sensibly perceived, than in the insensible Transpiration of Human Bodies. For SANCTORIUS affirms, that he by an exact weighing of himself, found that more than one half of our Food and Drink, passeth by insensible Transpiration; and that we evacuate more of our Aliments through the pores of our Skin, in one day, than we do by Siege in 15 days; which is an incontestable proof of the Steams that continually proceed from our Bodies.

XVI.
But most of all from Human Bodies.

CHAP. II.

Of Winds.

WINDS are more frequent in the Spring and Autumn, and do blow with greater violence, than in Summer or Winter.

The Reason why it thus happens in the Spring is, partly because of the melting of Snow, especially in Mountainous Places; and partly because the pores of the Earth are then opened, and send forth more Steams or Vapours; and partly also because the Air and Vapours are then more rarefied than in Winter. And in Autumn, the reason is to be ascribed to the frequency of Rains that then fall, as well as to the greater quantity of Exhalations; because the Suns moderate heat, which then takes place, doth raise Vapours and Exhalations, but gross ones, and not sufficiently rarefied. Whereas in the heat of Summer, there are for the most part no winds, for the same reason that Rains are very scarce then; and because the Sun doth too much extenuate the Exhalations, and so prevents them from uniting in that quantity, which is requisite for the Generation of Winds. And in the midst of Winter, winds are less frequent, not only because less quantity of Vapours is at that time raised from the Earth, but also because those which are so raised, are either condensed into Snow, or at least by reason of the cold, are not so rarefied and dispersed as to be able to produce a Wind.

About the Suns Rising, an East wind is commonly perceived, and about Sun Set a Western: which difference they are most sensible of, who sail in the Ocean, at a great distance from Land.

This proceeds from the presence of the Sun, which puts the particles of the Earth in motion, and lifts up Vapours into the Air: For seeing that a great part of the Earth is always illuminated by the Sun, it must of necessity raise many Vapours from thence, which upon its departure fall down again, and betake themselves to the East and Western parts of the World, to succeed in the room of those Vapours which the coldness of the Night hath condensed in those parts: And therefore they

I.
Why Winds are more frequent in the Spring and Autumn, than in other Seasons of the Year.

II.
Why an East Wind commonly blows in the Morning, and a West wind in the Evening.





Figure
24.

who live in the *Eastern* parts, perceive an *East-wind*; and those in the *West*, a *West-wind*. This will appear more clearly by considering the *Figure*, where *A B C D* represents the Compass of the *Earth*, *S*, the *Sun* opposite to it, who darting his *Beams* against the *Hemisphere A B C*, and making *Noon* at *B*, and *Midnight* at *D*, doth at the same time Set to the *People* that live at *A*, and Riset to them who live at *C*. For the *Vapours* about *B*, which are rarefied by the Heat of the *Day*, and do by opposite ways tend towards *D*, viz. by *A* and by *C*, to take up the place of those *Vapours*, which the Cold of the *Night* hath condensed, do produce a *Western-wind* at *A*, where the *Sun* sets; and an *Eastern-wind* at *C*, where the *Sun* riseth.

III.
Whence the
difference
of Winds
doth pro-
ceed.

Whence it follows, that the *Fermentations* that happen between the *Tropicks*, produce *Winds* that are either contrary to, or agree with the *East-wind*, according as that part of the *Earth*, where they are generated, is differently situated with regard to the *Sun*: Whence it comes to pass, that the *East-wind*, which reigns constantly betwixt the *Tropicks*, is sometimes stronger, and at other times weaker, as Experience sheweth.

I have said before, that this diversity of *Winds* is most of all perceptible to them that *Sail* in the vast *Ocean*; because at *Land* there be many things that hinder us, that we cannot so well observe this order of the *Winds*, viz. the height of *Mountains*, and the great variety of *Climats*.

IV.
Why East-
winds are
drier, than
West-
winds.

East-winds for the most part are dryer, and produce fair and clear weather; whereas those from the *West* are commonly moist, and bring *Vapours*.

The Reason hereof must be deduced from the motion of the *Air*, which is carried about the *Earth* from *East* to *West*: For seeing that the *Winds* that are generated at *C*, follow the motion of the *Air*, they consequently drive before them all the *Vapours* they meet with, and dissipate them, and so hinder them from being condensed and turned into *Rain*. But those which are produc'd in the *West* *A*, seeing that they strive against the motion of the *Air*, and take a different course from it, they stop the motion of the *Vapours* they meet with, and drive them together into *Clouds*. And for the same Reason, winds that proceed from the *East* *C*, are generally stronger, and blow with greater force, than those that blow from the *West* *A*; because those which are forged at *C*, follow the course of the whole Mass of *Air*. Or else, because by reason of the longer absence of the *Sun*, the *Vapours* are more closely condensed in that part of the *Earth* which is between *C* and *D*, than in that which is betwixt *D* and *A*. Now it is certain, that the *Condensation* of *Vapours*, contributes to the force and violence of winds; which are by so much the more vehement, the more heavy the parts are whereof they consist.

V.
Why about
the Sea-
Coasts, the
Wind at
Night
blows from
the Land,

On the *Sea-Coast*, the winds are found to blow from the *Sea* in the *Day-time*, and from the *Land* in the *Night*.

This shifting of the *Wind* depends on the Illumination of the *Sun*, whereby it differently raiseth up *Vapours* from the *Sea* and *Earth*. For whilst the *Sun* shines, he commonly raiseth more *Vapours*

from the *Sea*, than the *Earth*; because the *Earth* is dry in many places, and doth not afford such plentiful matter for *Vapours*, as the *Water*: And, on the contrary, when the *Sun* withdraws, more *Vapours* rise from the *Earth*, than from the *Sea*; because the *Earth* being a compact *Body*, and abounding with moisture, doth longer retain the Heat impressed upon it, than the *Sea*. And therefore those strong winds, which blow from *Midland* places upon the *Sea*, are strongest next to the *Shoar*; but grow weaker, the further they proceed on the *Sea*. From whence *COLUMBUS*, the first Discoverer of the *West-Indies*, gather'd, that there were other *Countries* beyond the *Atlantick Ocean*, and those not far off neither; because he found such strong and violent winds to blow from the *Sea* towards *Europe*, which he concluded to be too vehement to proceed from the *Sea*.

There be some *Winds* that return at certain times, and always observe the same course; as the *Etesia*, which every Year blow for 40 Days together, beginning 2 days after the Rising of the *Dog-Star*. *West-winds*, which blow from the *Vernal Equinox*, to the *Autumnal*, in the *Mediterranean Sea*: And *South-winds*, which are produc'd under the *Torrid Zone*, and have their daily, monthly, and 6 monthly Returns, or Reciprocations.

The *Sun* is the only Cause of all these constant or stationary winds, who, according to his various approaches to, or recesses from the several Parts of the *World*, effects this great diversity herein. For as to the *Etesia*, which are observed after the *Summer Solstice*, it is probable that they proceed from *Vapours*, sublimed by the virtue of the *Sun* from the *Earth* and *Water*, that are in the Northern parts, after that he hath continued a great while about the *Tropick of Cancer*. For it is certain, that he continues longer at the *Tropicks*, than in the Space that is between them. And we are to consider, that in the Months of *March*, *April* and *May*, the greatest part of the *Clouds* and *Snow* which were about our *Pole*, are resolved into vapours and winds; and that these winds, from the beginning of the *Spring* (at which time they are at the strongest) towards the *Summer Solstice* do grow weaker, as the Matter of them decreaseth. And that in *June*, the *Earth* and *Water* is not yet sufficiently heated there, to furnish Matter for a new wind: But when the *Sun* continues about the *Tropick of Cancer*, they become more strongly heated, and by this means produce the *Etesia*, when the *Noon* of that long *Day*, which continues there 6 Months, begins a little to decline.

These *Etesia* have a great affinity with the winds called *Ornithia*, which blow from *South* to *North*, and bring back the *Birds* from the beyond *Sea* hotter *Countries* into *Europe*, and are therefore called *Ornithia*, or *Bird-blowing-winds*. But yet sometimes these winds stop in the midst of their course; and therefore it is observed, that *Swallows* are very rare in *France*, when *North winds* have blown much towards *Africa* at the beginning of the *Spring*.

6 X

Experience

and in the
Day-time
from the
Sea.VI.
What the
Cause is of
the winds
called
Etesia,
and of
other Con-
stant
winds.VII.
The winds
called Or-
nithia, are
near akin
to those
Etesia.

VIII.
In the Indian Seas, and those of Arabia, the Winds blow constantly.

Experience teacheth us, that in the *Indian* and *Arabian Seas*, which are so situated with respect to the Continent of *Asia*, when the *Sun* heats the same from *April* to *October*, the *Air* which is condensed on the South-side of the *Aequator*, doth transport it self with so much impetuosity, towards the North-side of it, that it makes the *North-east-wind* not to be perceived, which blows at the same Latitude in the *Atlantick Ocean*. And, on the other hand, when the *Sun* doth heat the *Seas* which are on the South-side, from *October* to *April*, then the *Air* which becomes condensed towards the North by the Cold of the *Winter*, that remains there, doth take its course with that violence towards the South, that it doth entirely over-power the *South-east-wind*. Which is the Reason, why in these *Seas* there is only perceived a *Periodical-wind*, which blows one half of the Year on one side of the *Aequator*, and the other on the other side.

IX.
The West-winds blow at a certain time of the year in the Mediterranean.

In like manner *West-winds* usually blow in the *Mediterranean-Sea*, from the time of the *Vernal Equinox* to the *Autumnal*; because a great quantity of *Vapours* is, during the Heat of *Summer*, drawn up from the *Atlantick-Ocean*; and some Hours after *Sun-Rising*, which answer to a set space of Time after *Midnight*, are driven towards the *East*, and continue their activity till *Sun-setting*. The winds betwixt the *Tropicks* are certain and stationary; because the *Sun* there darting direct and perpendicular *Rays* towards the *Earth*, doth by this means raise many *Vapours*, which being put into motion by the Action of the *Light*, do diffuse themselves and produce a *wind*. And in like manner it may be said of other winds, which rise at certain times; as of the *Southwest-wind* by *West*, which blows from the *Eastern-shoar* of *Africa*, towards *Morambique*, from the beginning of *August* to the 15th of *September*; that they are caused by the *Sun*, who raiseth plenty of *Vapours* out of the *Indian-Sea*, from *April* to *August*, which take their course towards *Africa*, and having got more room, do there dilate themselves.

X.
How Artificial-winds may be made.

Winds may be raised by Art, as appears by that Instrument called the *Chymists Bellows*; which consists of a hollow *Copper-Globe*, so contrived as that it may be filled with *water*, and afterwards shut up close; having a *Pipe* with a very narrow Mouth jetting out from one part of it, which Instrument thus fill'd with *water*, is plac'd near a *Fire*, the *Pipe* being turn'd towards that *Fire* which is to be blown up: Whereupon, as soon as this *Globe* grows hot, the *water* becomes rarefied, and bursts forth through the narrow Mouth of the *Pipe*, in the manner of a strong blast or *wind*, and so serves for a *Bellows* till all the *water* be consumed.

In this case the particles of the *water* being agitated by the *fire*, dash together, and with strong Endeavours strive to get away from one another; and because they cannot dilate themselves, nor depart from each other, but only so far as some of them get out through the *Pipe*, all this force wherewith so many of them clash together, being united, doth drive the parts that are next to the *Pipe*, with great violence into the open *Air*, and by this means a blast or *wind* is caused. And forasmuch as by the *fires* continual Action, other

parts of the *water* are still rarefied, and being whirl'd about, do withdraw from one another, whilst others of them endeavour to get out of the *Pipe*; by this means the *wind* ceaseth not, until all the *water* that is in the *Globe* be evaporated, or that the *fire* be removed from it.

Winds do rage most in the *Winter*, and cause more stormy weather, than at other times; which *Sea-men* are very well aware of.

The Reason is, because the *Sun* at that time draws towards the *Southern Tropick*, and therefore occasions a less Resistance against the *North-winds*. To which may be added, That in the *Winter*, the *South-west*, or *South west and by West-wind* comes down with more force from the *Mountain Atlas*, or the *South-east-wind* from the Mountains of *Syria* and *Arabia*. But the *Winds* are never more stormy than in *March* and *September*, because the *Heaven* then is subject to many mutations, and frequent vicissitudes of heat and cold, moisture and drought.

The *South-wind* is, for the most part, unhealthful, and causeth Colds or Stuffings of the *Head*. Hence it is, that when the *South-wind* blows, People grow more peevish, and more unfit for their Studies.

The Reason is, because the *South-wind* being moist, carries many *Vapours* along with it, which enter into the open pores of the *Body*, and are carried to the Inward parts of it. Whence proceed Colds and Stuffings of the *Head*, and Dulness of the *Senses*, which when a man perceives, he is apt to be troubled and peevish; and consequently is less disposed for his Studies, or other Affairs, that require a clear and serene *Mind*.

Northern-winds do clear the *Air*, and cause Fair-weather.

Because by their impetuous blasts they drive away and disperse the *Clouds* that are already formed, and by their Coldness hinder the Generation of New ones: Whereas on the contrary, *South-winds* must needs produce a quite different Temperature in the *Air*, which is abundantly confirm'd by Experience in the *Ile of France*, *Burgundy* and *Campagne*, whither the *South-wind* always brings great Rains; for being opposed to the course of those *Vapours*, that are raised towards the *North*, and which blow towards the *South*, it stops them, and by its heat, doth in a short time change them into showers.

There are some winds that blow in some particular Countries only; as that *North-wind* which blows on the West-side of the *Alps*. Such also is the *North-east-wind* in *Apulia*, and in other places.

The Reason of these *Winds* must be deduced from the situation of the several Places, the Narrowness of the *Valleys*, and the Caverns of the *Mountains*. For it is evident, that a *wind* must blow with greater violence between the Streights of *Mountains*, by the same Reason that the *Water* of a *River* runs more swiftly where its Channel is straightest, because the Fore-parts of the *water* are prest forwards by those that are behind. And therefore it is, that a *WVind* that breaks from a straight place into an open Country, doth rage with an extraordinary violence.

XI.
Why winds are most vehement in the Winter.

XII.
Why the South-wind is unhealthful.

XIII.
Why the North-wind commonly brings fair weather, and the South-wind, Rain.

XIV.
Some winds blow only in some particular Regions.

The





XV.
Why the
North-
wind is
cold, and
the South,
hot.

The North-wind is generally Cold, because it passeth through a Region cover'd with Snow, whence it brings many cold Vapours along with it. But the South-wind is Hot, because it comes to us from those parts that are nearer to the Torrid Zone, whence it brings along many hot Exhalations, which the Sun hath call'd forth, which makes it to feel hot to us. This Mr. BOYLE made an Experiment of in a Weather-Glass, in which there was a hanging Cylinder, or long Glass-Pipe fill'd with Water, and after having blown into it with a pair of Bellows, the water did not fall down, as it happens when the Cold is increased; but on the contrary, the Glass-Pipe began to grow hot, and received some degree of warmth upon blowing in of the wind: But when the outside of the Bellows was surrounded with a mixture of Snow and Salt, a colder wind came forth from it, and made the hanging water to descend. By which Experiment it sufficiently appears, that all winds bring some Steams and Exhalations along with them, that impart a different Temperature to the Air, which they fan with their Blasts.

XVI.
The Winds
that blow
in Tempe-
rate Zones
are Irregu-
lar.

The winds that bear sway in these Temperate Zones, are generally irregular; that is, are tied to no certain Rules or Laws.

The Cause of this Inconstancy is to be fetched from the different situation of the Zones; for seeing that the Temperate Zones are placed betwixt the Torrid and the Polar frigid Zone, they sometimes receive the most intense heat from the former; and at other times, most extreme cold from the latter. Whereas the Cold and Hot Zones, for the contrary Reason, are accustomed to more Regular winds, which at certain set-times use to be very violent. Thus because Southern-winds with us, do most of all depend on the different force of Exhalations, therefore also they are free, and tied up to no Laws.

XVII.
Winds
blow regu-
larly only,
on the
Main Sea.

But after all, it may be said, that winds are scarcely Regular to exactness, save only on the Main-Sea, where the Fermentations that commonly happen in the Earth, cannot produce any Alteration; and that on the contrary, on the Land and in Seas, that are not very far from it, the winds must needs appear with all the Irregularities imaginable; not only with respect to the different parts of the Horizon, whence they blow, but also with respect to the force wherewith they exert their activity.

XVIII.
The most
violent
Winds are
dry, and
the most
gentle are
the moistest.

The most violent winds are such as are dry; and the most gentle and soft, are those that are moistest.

The Reason is, because the most violent winds are able to carry away with them the watry particles that are in the pores of Bodies, that are exposed to their action; whereas on the contrary, the softest and gentlest winds must needs be the moistest; not only because the particles of Air, and the Vapours whereof they are composed, are not of force enough to carry away the particles of the water, which are either in the pores, or on the surface of Bodies which they meet with; but also because the Vapours which are in the wind, being only endued with a small degree of Agitation, do stop at those Bodies, and make them moist.

XIX.
Why the
Wind hath
so great
force
against
the Sails
of a Ship.

A wind blowing against a Plate of Iron, or a wooden Board, exerts but little force upon it; whereas when it is driven against the Sails of a Ship, it hath so great a force as to drive forwards the greatest Ships so swiftly, as that they can run near 80 Leagues in 24 Hours.

The Reason of this difference is to be ascribed to the difference of the pores in these several Bodies; for those that are in Sails are formed by the weaving of Threads, through which, when the wind passeth, it doth as it were divide it self at the several Threads of the Sail, that separate the pores from each other, and exerts its force against them: Like a Torrent of water, which exerts a greater violence against a Dam, that hath slits or intervals between them, than against a wooden Board, or a stone Wall, which affords no passage to any part of the water.

XX.
Why the
Wind is
felt colder
than the
Air, where-
as indeed
it is not
colder than
it.

Winds seem to be colder, than the still and calm Air, tho' they be little or nothing colder than it, as may be seen in a Weather-Glass, in which the water doth not mount higher when the wind blows, which yet ought to be, in case the Air that is shut up in the Glass, were made colder by the outward wind.

The Reason is, because the still Air doth only reach the outside of our Skin, which being colder than the Flesh which is hid under it, is therefore less sensible of the Cold that comes against it: Whereas the wind being more agitated, is driven deeper into our Bodies, and piercing the Flesh, is conveyed into the Inward parts, which being much hotter than the Skin, are more sensible of the coldness of the wind that reacheth them. For the same Reason that a hot Hand is made sensible of more cold when it touches a piece of Ice, than a Hand which is only luke-warm.

CHAP. III.

Of Clouds and Mists.

Clouds are suspended and poised in the Air, tho' they seem to be thick and heavy.

The Reason is, because the particles of Ice, or Snow, whereof they consist, are very small, and of much Surface, according to their bulk; and therefore are more hindered by the resistance of the Air from falling downwards, than they are driven down by their own weight; much like as a heavy laden Ship is born up by the resistance of the water that surrounds it. Besides, the winds that commonly blow near the Earth, consisting of a more thick and gross Matter, than those which are in the higher parts of the Air, are not only of force enough to stay and poise the Clouds in the Air; but also to raise them above that part of the Air wherein they are. Again, tho' the particles of Ice, being driven by the wind, do become contiguous to one another; yet are they not therefore closely joyned together, but on the contrary do constitute a Body which is so loose, light, and diffused, that except heat do melt some of the parts of them, and by this means do condense and make them more heavy, they would never be able to fall to the ground.

I.
How Clouds
come to be
poised in
the Air.

Mist

II.
Why there
be more
Mists in
the Spring,
than at
other
times.

Mists are very frequent in the Spring, more than at other Seasons of the Year.

The Reason is, because at that time there is a greater Inequality between the heat of the Day and the cold of the Night; by which means it happens that a great quantity of Vapours do meet with the Coldness of the Air. For there are two things required to the turning of Vapours into Water or Ice: The first is, that their particles come so close together, that they may touch one another: The 2d is, that there be Cold enough to stop and unite them, when they are come thus close together. For the Cold would be of no use, if the particles of the Vapours were at a distance from one another, and separated. And their Connexion would be of as little use, in case the agitation of Heat were so great to hinder their union. And therefore when in the Spring, Vapours are carried upwards by the heat of the Day, which by the cold of the following Night are again condensed, it cannot be otherwise, but that Mists must more frequently appear at that time, and the Earth be more abundantly moistned with them. And for the same Reason it is, that on the Sea-Coast, and in Marshy places, Mists are more frequently generated than in Upland places, and such as are remote from the Sea; for the Water in those places sooner losing its heat, than the Earth, imparts a coldness to the Air, where afterwards the Vapours, that proceed in great abundance from the hot and moist Earth, are condensed.

III.
What is
the Cause
why one
Cloud
seems to
lie upon
another.

Sometimes a double range of Clouds appear in the Air, whereof the one is carried below the other.

The Reason is, because the Vapours, of which the Clouds are generated, do not with an equal force mount up into the Air, but some get up higher than others, before that they are sufficiently condensed for the forming of them. Whence it is, that we see some of them further from the Earth, and others nearer to it, and these too sometimes driven by different winds. Which is more especially perceived in Mountainous places, where the sublimed Vapours are more unequally driven by the heat, than in other places. Hence it is, that according to the greater, lesser, or equal weight of the Cloud, the same Cloud doth either ascend, descend, or hang equally poised in the Air: As a Ship, according to her greater, less, or equal weight, doth rise higher, sink lower, or keep in an equal station in the water.

IV.
The highest
Clouds con-
sist of Ice
particles.

The highest Clouds are composed of particles of Ice, which may be gather'd from the Tops of the highest Mountains, which even in the midst of Summer are cover'd with Snow.

The Reason is, the great Coldness of that Region of the Air, which without doubt is colder, than that which lies upon the tops of the Mountains, or at least as cold; and because the Vapours, the higher they ascend, the more cold they meet with to condense them; and are the less liable to be pressed by the winds; therefore, for the most part, do the highest parts of the Clouds only consist of the thinnest Capillaments of Ice, situate at a great distance from one another.

V.
What is
the Cause
of the va-

Clouds appear of different Colours, sometimes black, at other times white, and sometimes are painted with all the Colours of the Rainbow.

A Cloud appears black, when little or no Light is reflected from it, and then it is a sign of Rain; because the lower part of the Cloud is either already turned into water, or will be so suddenly. So on the other hand, when the Light is reflected from the Cloud, only by changing the Order of the Rays lighting upon the Cloud, without any other change of the Beams, then the Cloud appears white, and is a fore-runner of Fair-weather; because the said Cloud, consisting of distinct Globuli, or round particles, doth more readily vanish into the Air. And so lastly, when the Light is reflected from a Cloud in the same manner, as it is sent back from the Matter of a Rainbow; then that Cloud appears of many Colours, like a Rainbow, viz. Red, Green, and Purple, and may be a sign of Changeable-weather.

Mists commonly are generated in the Morning, when a clear Night hath gone before, and when the weather is calm and free from the least Blast of wind. And if any one of these be wanting, either no Mists at all do arise, or if they do, they presently vanish.

The Reason is, because a Mist chiefly riseth from a Vapour, which breaks forth from the surface of the Earth, being raised by a gentle heat, from Boggy places and Rivers, especially if they run slowly. Wherefore if the Heat be over-great, it doth too much dilate the Vapours, and makes them fly upwards and vanish away. The extream sharpness of the Winter coldness, and great and violent winds, are also a hindrance to the production of Mists, because then the Vapour cannot be kept in by the ambient Cold, and the Thickness is lost, which is necessary to the constitution of a Mist. Moreover, a Rainy or Cloudy Night, hinders it, because the Rain extinguisheth that warmth which is necessary for the raising of Exhalations. Lastly, When a Cloudy Night hath gone before, no Mist will ascend; for seeing that no Dew falls at that time, there is no matter for the raising of Vapours; and therefore it is necessary in order to the forming of a Mist above the ground, that the weather be still and calm, that the Earth be warm, and that a fair Night hath gone before.

A Mist is dark and dusky, and deprives us of the Light of the Sun.

The Reason is, because a Body that consists of many particles so ranged, that the Light, by reason of the said parts lying one upon the top of another, is the less transmitted, the deeper it drives amongst these little Bodies; such a Body as this is, I say, tho' at first it be transparent, yet will at last, by this its swallowing up of the Light, become dark and dusky. For after this manner it is, that beaten Glass, foaming Waves, and a thick or close Wood become Dark or Dusky. And the same is the case with a Mist: For water attenuated into its least particles, which is a Vapour, and the Matter of a Mist, tho' with these its divided particles it be so tost up and down in the Air, that it scarcely hinders the strait course of the Light; yet when the said particles come together again, it constitutes some Drops, which tho' every one of them singly taken be transparent, do so receive the Light, that not so much as one of the beams is transmitted or passeth through the whole heap of them.

When

rious Co-
lours of
Clouds.

VI.

Why Mists
commonly
arise about
the Morn-
ing.

VII.

Why a
Mist is
dark and
dusky.

VIII.
When a
Mist is a
sign of
Rain.

When a *Mist* having its parts united is carried downwards it threatens *Rain*; but if it be rarefied by degrees, and so ascend, it is a sign of fair *Weather*.

The Reason is, because when a *Mist* in an united *Body* is carried upwards into the *Air*, it joyns to its self many *particles* of *Dew*, which are scattered up and down the cold morning *Air*, which being soon after put into a motion by the least heat, are dissolved into *Rain*. Whence we observe that a *Mist* is often suddenly raised, whereas the *Sky* before was very clear, and promised nothing less than *Rain*. For the heat agitating more forceably the little *drops* whereof the *Mist* doth consist, makes many of them to run together, into such great *drops*, that the *Air* being no longer able to bear them up, they are forced to fall down in *Rain*.

IX.
Great Mists
and Clouds
are generated
by the meeting
of two
Winds.

When 2. or more *Winds* meet one another in their course, then *Mists* are formed in the place of their meeting.

The Reason is, because these *Winds* drive many *vapors* together to that place, which being united do either form *Mists*, if the *Air* thereabouts be very cold; or else produce *Clouds*, if the neighbouring *Air* be not cold enough to condense them, and so the matter of these *Vapors* mounting up higher into the *Air*, is there by the coldness of the place coagulated into *Clouds*. Yea, sometimes such a vast quantity of *Vapors* is gathered together in those places where 2. or more *Winds* meet, that the *Winds* cannot pass for them, neither above, nor under them, and so are forced to move round them, by which means they form a great *Cloud* of the said *Misty* matter, which being pressed on all sides by the *Winds*, gets a round and smooth surface.

X.
A Mist
magnifies
and lessens
Objects.

If a *man* be look'd upon through a *Mist*, he appears like a *Giant*: Whereas the *Sun* being beheld through it, appears much less.

The Reason is, because many *Rays* are refracted in those *drops*, whereof the *Mist* doth consist, which being gathered within the *Eye*, do dilate and extend the *Object*. But the *Sun* appears less, because the *Beams* proceeding from him, by reason of their great distance are dissipated, and do not all of them light upon the *Eye*; so that some of the lateral *Rays* are lost, which are wont chiefly to magnifie *Objects*.

CHAP. IV.

Of Rain.

I.
Why the
Drops of
Rain are
round.

Drops of *Rain* as they fall down do settle themselves into a Round or Globular figure.

Some suppose this to proceed from an innate instinct in things, whereby they endeavour to preserve themselves from destruction; and that therefore the *drops* of *water* reduce themselves into a round figure, the better to preserve themselves from the injury of the *Air*, or the action of any other *Body* coming in their way. But this is to attribute *Understanding* and *Will* unto insensible things. Say we rather that the *drops* of *water* become smooth and round, by means of the *Heavenly Globuli* which surround them, and thrust themselves within the *Pores* of them. And because the *Heavenly Globuli* have another moti-

on amongst the parts of the *water*, than in the ambient *Air*, and endeavour to move in right lines, thus it comes to pass, that those of them which wander in the *Air*, are less hindered in their motion, when the *drops* of the *water* they meet with are Globular, than if they were of any other figure. Wherefore if any part of them chance to be prominent and not comporting with a Globular figure, the *Heavenly Globuli* in their Career through the *Air*, do with greater force dash against these prominences, than against the other parts; and so drive them towards the *Center*. But if the said part chance by this force to be driven too near the *Center*, then the *Heavenly Globuli* that are within the drop, do with greater force, drive it from the *Center*, and by this means it is that all *drops* of *water* are formed into an exact Spherical figure.

Hence it is, that when *drops* touch one another they lose their roundness, and run together; for in the point where *drops* touch, the *Aethereal water* presses them more weakly than in others, and doth not drive all the parts of them equally towards the *Center*, as it did before.

It happens sometimes in the *Summer*, and in still and calm *Weather*, accompanied with great and sultry *Heat*, that *Rain* falls, before any *Cloud* can be seen.

The Reason is, because the *Vapors*, which are then in great quantity in the *Air*, being pressed upon by the *Winds* of other places, as appears by the calmness of the *Weather*, and the fultriness of the *Heat*, are turned into *drops* of *Rain*, which fall down as fast as they are formed in the *Air*.

In some *Countries* it never, or very seldom *Rains*, as in *Egypt*, and more especially the upper parts of it. And the same is also asserted by PLUTARCH concerning *Lybia*, and some *Countries* of *India*, which are always dry, and never refreshed with any *Moisture*.

I cannot conceive that this is to be ascribed to the over-great *Heat* that reigns in those *Countries*, seeing there be others that are much *Hotter*, where it doth *Rain*. Wherefore the cause of this want of *Rain*, may with greater probability be attributed to the *Dryness* of the *Earth*, and the disposition of its parts, that have no water hidden under them, which being turned into *Vapors* might produce *Rain*; or if there be any such *Moisture*, yet because of the over-close compactness of the *Earth*, the same cannot get out into the *Air*. For as *Dogs* do never sweat, because of the compactness of their *Skins*, which is such that they cannot make way for the *steams* to get through: So the ground of *Egypt* may be of such a close and compact texture, as not to have *Pores* large enough for the transmission of *Vapors*. Neither can the *Etesiae*, which blow from the *Mediterranean Sea* towards *Egypt* convey any *Clouds* thither, that might turn to *Rain*; for it is not probable, that *Vapors* can be carried so far by the force of *Winds*; and besides, these *Winds* are not continual, but altogether cease at the first approach of the *Night*.

Rains are more frequent in some *Countries* than in others, as in *Languedoc* in *France*, and in *Ireland*, &c.

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II.
Why Drops
lose their
roundness
when they
run toge-
ther.

III.
Why it
Rains some
times in
the Sum-
mer when
no Clouds
appear.

IV.
Why it
doth not
Rain in
Egypt, and
some other
Countries.

V.
Why Rains
are more
frequent
in some
Countries
than they
are in o-
thers.

The Reason is, because the Situation of these Countries is such, that the Clouds which proceed more abundantly from the Sea, than the Earth, being full loaden by that time they come there, are forced to fall to the ground. It is found by experience in *Languedoc*; that the Clouds that come from the West, where the Ocean is, and those which rise from the South, where the Mediterranean lies, are so loaden with Rain, the former when they arrive in the upper *Languedoc*, and the other in the lower, that they can pass no further without falling down: But yet so as that those Clouds that come from the Ocean, do seldom come to the lower *Languedoc*, nor those from the Mediterranean to the upper; whence it is that it seldom Rains, with a West or North-west Wind beyond *Carcaffone*, in the way towards the lower *Languedoc*; as it very rarely Rains with a South Wind, or South West, beyond the same City, towards the upper *Languedoc*. And forasmuch as the force of these 2 Winds is spent about this place, it cannot be otherwise but that the Clouds must there fall down into Rain, which is the very reason why the Rains are so abundant about that City.

VI.
What is the cause of those continual Rains that fall betwixt the Tropicks.

Between the Tropicks almost continual Rains fall from July to September.

The Reason is, because the Sun at that time doth extremely rarefie the Air that is in the Northern part of the World, which makes the Air that is in the South part, to drive that way, and in its passage takes along with it all the Vapors that arise from the Sea of *Aethiopia* and the *East-Indies*, which are very copious, and being come between the Tropicks, where the Air is hotter than else where, they are forced to turn into many small drops, which falling down in Rain, abundantly moisten the Earth, and make the heat of those Countries the more supportable.

VII.
What is the cause of the raining of Milk and Blood.

It Rains sometimes Milk and Blood. Thus *PLINY* tells us in the 56 Chapter of his natural History, that it rained Milk when *M. Acilius* and *C. Porcius* were Consuls. And *LIVY* makes mention of a Bloody Rain in his 4 Decad Book 9th which fell for 2 Days together, in the Yard of the Temple of Concord. And amongst our modern Authors *GEMMA FRISIUS* relates *Libro 2. Cosmocrit. cap. 2.* that in the County of *Embsen* in *East-Friesland* it rained Blood one Night in that abundance, that for the space of 5 or 6 miles all the Herbs and Linnen Cloth, and all things else exposed to the Air, were changed into the colour of Blood.

GASSENDUS supposeth Milky Rain to be nothing else, but a Whitish water, made so by the mixture of some Particles of Lead, Sugar of Saturn, Saltpeter and Vinegar, which are proper to tinge water of a White colour. And that a Bloody colour'd Rain proceeds from Vitriolick and Bituminous Steams, which impart a Red colour to the drops of Rain, as soon as they reach the ground. But it seems more probable, that these Rains are the product of Vapors, which proceed from places that abound with Red-Lead, or Ruddle: As Historians tell us, that Red Snow sometimes is seen to fall in *Armenia*, because of the Red-Lead wherewith that Country doth abound, or from places where much Blood hath been shed; or this Red colour may be occasioned by the extreame heat of

the Sun; as we see that the Urines of those who are sick of an Ague or Fever, look Red, and the water that is made to run through hot Althes acquires the same colour.

Some are of Opinion that the Bloody Spots which sometimes are seen upon Stones, do not proceed from any Rain of Blood, but are caused by Caterpillars which turn to Butter-flies, and upon the changing of their Skin, leave those Bloody spots behind them: Which they confirm by this, first, that these spots can scarcely be ever washt off with water; and in the next place, because they are never found on the tops of Houses, and very rarely in Towns, but frequently in the Country, and in those holes where Caterpillars commonly do nestle.

What some relate of a Silver Rain, is not so altogether improbable, that it should be rejected as fabulous; seeing it is possible for Quicksilver to be sublimed so high in the Air, as that afterwards it may fall down in drops again, which may very well by the common people be taken for Silver drops. And that this is the true cause of this kind of Rain, may be confirmed from what the Historian *DION* hath Recorded, that it rained Silver in the Reign of the Emperor *Severus*, which lighting upon pieces of Copper communicated the colour of Silver to them, which after 3 days time vanished again.

AVICENNA tells us, that a Calf fell down from Heaven to the Earth in a great Storm of Rain.

I do not think that *AVICENNA* ever supposed that this Calf could be produced in the Clouds, or that there is any matter in them proper for the generation of Animals: But only that the Calf might have been snatcht up with a Whirlwind, and cast down elsewhere with a shower of Rain. For the Fluid substance of Heaven is altogether unfit, for the forming of such Bodies; neither could a thing of that weight be kept up in the Clouds, but would fall down, before it was fully formed.

And we are to pass the same Judgment, concerning that Norway Mouse called *Lemmar*; for tho' it be supposed to come down out of the Clouds, yet *OLAUS* upon dissecting of one of them found some raw Herbs in its Stomack, which is a pregnant Argument, that it was never generated in the Air, but snatcht up from the ground by some strong Wind, and carried into Norway, as it is certain that Locusts are sometimes after this manner carried from one place to another.

There is nothing more common amongst both ancient and modern Writers, than the Raining of Frogs, wherewith the Fields, Hills and Ways have been frequently after such a shower, covered and annoyed.

Tho' I dare not absolutely deny, but that Frogs may be generated in the Clouds; yet neither can I wholly assent to those, who do so confidently assert it. My reason is, because we never read of their falling upon the Tops of Houses, or into Rivers, but either in the high ways, or other places abounding with dust, and perhaps their Spawn, of which, upon the falling down of the Rain it is probable they are formed. This conjecture of mine is confirmed by *ÆLIAN* in his 2 Book of Animals Chap. 5. I remember, saith he,

VIII.
What is the cause of those Bloody spots, that are sometimes seen upon Stones

IX.
The cause of a Silver Rain.

X.
Whether it be true what *Avicenna* relates, that a Calf rained down from Heaven.

XI.
Of the Mouse called *Lemmar* which falls from the Clouds in Norway.

XII.
What is the cause of the Raining of Frogs.

he, that in my Journey from Naples towards Di-
cearcia, it rained Frogs, that had their fore-
parts formed, so that they crept with their fore-
Legs, whilst the hind part of them was nothing,
but a muddy slime without form. Which is a
very pregnant Argument, that these Frogs were
formed out of a Seed in the said Dust, mingled
with the fallen drops of Rain, and that conse-
quently they had their rise not in the Clouds, but
on the Earth. Besides, when should the Air or
Clouds be furnished with matter, proper for the
generating of such vast multitudes of Frogs? Or
how could they be kept up in the Air without
falling down? Or why should they at last fall
down, before they were perfectly and fully form-
ed? Wherefore it is most probable, that these
and all others that seem to come down from the
Clouds, are generated in manner as above said.
Thus we see, that after the over flowings of Ri-
vers many Insects do swarm in the Fields: And
that after Rain, a vast number of Snails are pro-
duced; so likewise Oysters and other Shell fish
are sometimes formed of the drops of Rain, mixing
with Mud or Slime.

XIII.
The Seed
of Frogs
may be
carried up
to the
Clouds.

Except it be said that the Seeds of these Ani-
mals, being mingled with the Vapors or Winds,
may be sometimes carried up to the Clouds; as
they are at other times to Pools and other places,
abounding with Mud and Moisture. As we read
that Coals, standing Corn and other such like
things, have been carried away by the Wind into
other places, where falling down, the people con-
cluded that it rained Coals, Corn, &c.

XIV.
But it is
most pro-
bable that
they are
generated
on the
Earth.

But indeed it seems more probable, that these
Frogs were at first generated in Ditches or other
places, but that at first they are so little as not to
be perceptible by the Eye, they being for some
days after they are first hatcht very small without
Feet, and with a long Tail, without bearing the
least resemblance with Frogs; and do afterwards
by degrees get Feet, and lose their Tails. So
that hiding themselves under the Hedges, and un-
der the Grass, it is a difficult thing to discern them
from the Dust or Mud of the Ground; so that
the Rain serves only to bring them forth out of
their lurking Holes, and present them to our view.
And that this is so, we have the greater reason to
believe, because Food hath been found in their
Stomachs, and Excrements in their Guts. So
that we may well conclude, that these Frogs are
not then formed, but only do then first appear,
tho' they were long before.

XV.
The Sun
shining at
a time
when the
Heaven is
covered
with
Clouds, is
a great
sign of
Rain.

The Sky covered with Clouds, is a sign of Rain,
tho' the Sun may shine very clear in the East.

The Reason is, because there are no other Clouds
in the Neighbourhood of our Air towards the
East, which might hinder the Heat of the Sun,
from condensing those that hang over our heads,
or raise new Vapors from the Earth, whereby
the said Clouds might be encreased. But this
cause taking place only in the Morning, if it
doth not Rain before Noon, it can be no sign of
what will happen in the Evening.

XVI.
Signs of
Rain taken
from in-
animate
things.

Other signs of approaching Rain are these; the
Sun shining bright early in the Morning, or ap-
pearing of a Blewish colour; for this is a token,
that there is great store of Vapors in the Air. So
likewise when the Moon appears of a Pale colour,
it is a forerunner of Rain: And when the Stars

seem to twinkle more than ordinary. Yellow
Clouds also near the rising of the Sun, are a
prognostick of Wet-weather; but the same colour'd
Clouds in the Evening, do promise Fair-weather
the next day. For the Vapors at Sun-rising are
carried upwards, and are resolved into Rain.

From other inanimate things and Animals, Prog-
nosticks may be taken of the changes of Wea-
ther; for the subtil Vapor which is diffused in
the Air, enters into the Pores of their Bodies.
Hence it is that Doors creak, that Wood laid upon
the Fire crackles. And as for Animals, Kine lift up
their Heads towards Heaven, Gnats and Flies sting
more violently, Hogs pick straws, Earth worms
creep forth out of the Earth, Pismires retire to
their hillocks, Leeches swim on the top of the
Water, because they then lye in wait for Flies
and other Insects, which the steams or winds do
bear down toward the Earth. Frogs croak more
frequently, because they delight in a moist Air;
or because they are more prest upon by the lower-
ing Clouds.

XVII.
Signs of
the Wea-
ther ap-
pearing
in Living
Creatures,
and other
things.

The drops of Rain are commonly greater in the
Summer, than in the Winter.

XVIII.
Why the
drops of
Rain are
greater in
Summer
than in
Winter.

The Reason is, because the drops in the
Summer, do fall down from a much higher
place, and having a long tract to pass through
the Air, they grow bigger in their passage. For
Rain falls from the Clouds 2 several ways, either
when the lower Air by giving way, or the up-
per Air by falling upon the Clouds, doth give
them occasion to fall down. Wherefore when the
Air that is under a Cloud doth contract it self, then
a small Rain like dust falls down upon the ground.
So in Egypt no Rain is known, but what falls
down in very small drops. But thick Rain and
violent Showers happen when a Cloud descends
being born down by the Air that is above it; for
then the drops of Water falling down from a great
height, do meet with other particles of water,
and joyning with them become greater than they
were before.

CHAP. V.

Of Hail and Snow.

HAIL falls more generally in the day
than at night, and oftner in the Spring,
Summer and Autumn, than in the Winter.

The Reason is, because a Cloud cannot be mel-
ted but by Heat, and therefore it is that Hail falls
only at that time, when there is sufficient Heat to
produce this effect. Wherefore tho' Hail may be
generated in the Winter, Spring, Summer and
Autumn, and in the night, as well as in the day;
yet does it fall more seldome in the night, and in
Winter, because then the Heat is too weak to be re-
flected up to the higher Clouds, so as to dissolve
them into drops of water of which Hail is
made.

Small Hailstones are sometimes Transparent;
whereas the greater are only so towards the Sur-
face, having some Snow within them, and are of
a white colour.

The Transparency of Hail proceeds from the
coldness of the Wind, which freezeth the drops
of water into Ice. Because in this case, the Pores
remain much the same as they were before in the
water,

I.
Why Hail
falls more
commonly
in the day
time than
at night.

II.
Why the
less Hail-
stones are
Transpa-
rent and
the greater
Opaque.

water, through which the Globuli of the 2d Element passing without hindrance, transmitted the action of Light every way in Right lines: As was said before concerning Glass. But when the cold VVind approacheth the Flocks of Snow, that are not quite melted, it drives the Heat, that is, the most swiftly agitated subtil matter into their Pores; because the VVind it self, cannot so easily or so swiftly enter them as the Heat or subtil matter that is in the Air can. Now when this Heat is thus shut up within the Pores of these Flocks of Snow, it endeavours to approach their Circumference, rather than their Centers, because the subtil matter (in the agitation whereof Heat consists) is more freely moved there, and so proceeds to melt them more and more, before they begin to Freeze again, and the most Fluid, that is, the most agitated particles of water, which are else where found in the said Flocks, approach to their Circumferences; the rest of them, which cannot melt so suddainly, abiding about the Centers of them. Which is the reason, why the greater Hailstones are Transparent towards their Surface, and inwardly of a white colour.

III.
What is
the reason
of the un-
usual great-
ness of some
Hailstones.

Sometimes Hail equal in bigness to great Stones falls down from Heaven. And I have heard an acquaintance of mine relate, that he had seen Hailstones as big as ten Eggs. And Historians relate of some that were no less than a mans Fist. In the year 1666, in Gelderland, some were seen of about 3 pound weight.

This bigness proceeds from the Cold VVind, by which the Hail is formed, which driving the Snow downwards from on high, drives many of the Flocks of it together, and by means of the Cold condenseth them into one Mass. Or else we may say, that such great Hailstones are generated in the highest Clouds, and that they encrease continually all the way they come down, and by this means grow into a great and extraordinary bulk. For it may so happen, that they may meet in their way with much moisture, which sticking to them, may be Frozen into one Mass with them. And by this means the Hail is encreased, by the addition of new Surfaces or Coats: As we find that Candles by repeated dipping into the melted grease, do still grow thicker.

IV.
Why Hail-
stones are
of different
figures.

Hailstones are sometimes of a Spherical figure, and at other times appear under various configurations. The Reason is, because the Flocks out of which the Hailstones are formed, being seized of the Cold VVind, are congealed by it. For if the Cold VVind, that is the efficient of Hail, meets with drops of water already formed, it makes the Hailstones round, save only that it frequently makes them somewhat flattish on that side, where it drives against them. But if it meets with Flocks of Snow that are not quite melted, then it frames them into irregular figures.

V.
What is
the reason
of the great
noise that
is heard
before the
fall of
Hail.

Commonly before the Hail comes down, a great noise is heard in the Air.

This is caused when the frozen drops dash against one another. And when this noise is heard some interval before the Hail falls, it is an Argument that the said Hail is formed in the upper parts of the Air; so that there is no necessity at all in this case, to have recourse to an Antiperistasis.

We find by experience, that the Snow whereof the Clouds do consist, becomes condensed, and reduced to a less extension.

To apprehend this well, we need only to consider that the Heat which commonly rarefies most Bodies, doth commonly condense Snow, the parts whereof are so scatter'd and divided, that the very least agitation is sufficient to bring them nearer together. Whence it comes to pass, that when the Air which is so near to the Earth, and is always hotter than that which is at a greater distance from it, begins to raise it self towards the Clouds, either by the driving of some VVind, or by the action of some new Fermentation, which causeth it to swell, it cannot but condense the Snow, whereof the Clouds do consist.

The particles of Snow are commonly figured like Stars, as may be perceived by catching the Flocks of Snow on a dry Cloth, and separating the parts of it from one another: Tho' sometimes also they be found Hairy, and sometimes in the figure of Roses.

The reason of this various Configuration is, because the Flocks of Snow, before that they fall to the ground, do undergo manifold changes in the Air, and according to the vicissitudes of Heat and Cold partake of different figures. Starry figured Snow is formed, when the Leaves of it, as the Heat approacheth, are melted leisurely, so that the Liquor into which they are dissolved spreading it self over the Surfaces of the Leaves, doth fill up all the little inequalities it meets with there; and makes them so smooth and even, as those parts of the Liquid Bodies are, tho' it presently after freezeeth there again. For seeing that the Heat then is no stronger, than what is required to resolve those small Capillaments, on all sides surrounded with Air, into water, the others still remaining whole and entire; it cannot be strong enough, to hinder that small quantity of water, that is fallen upon their Icy surfaces, from being congealed again by Cold. Afterwards this Heat passing through other Capillaments, which every one of the Flocks of Snow have in their Circumference, where they are surrounded with 6 other such like Capillaments, doth promiscuously bend this way and that way those Capillaments which are at the furthest distance from the 6 nearest Globuli, and by this means joyns them to those which stand over against these 6 Globuli. For these being kept Cold by the neighbourhood of the said 6 Globuli, do not melt, but on the contrary do immediately Freeze or turn to Ice, the matter of the others that are joyned to them; and by this means 6 Points or Rays are formed about every one of the said Flocks, which are capable of receiving divers figures, according as they are more or less compressed, the Capillaments thick and long, and the Heat which forms them slow and moderate. Again, Hairy Snow is generated, when the Icy particles whereof the Flocks do consist, are condensed by the Heat, and soon after being Frozen by the Cold, are turned about their Center, and are bound up by other Icy fragments. So likewise Snow formed in the figure of Roses is produced when the Rays that shoot out from the Snow, are bended by the Heat, and falling together with their points, are in that manner congealed again.

VI.
How the
Snow comes
to be con-
densed.

VII.
What is
the reason
of Starry,
Rose-like
and Hairy
Snow.

VIII.
Why Snow
is visible
in the
Night.

The *Night*, which renders most other *Bodies* invisible, hath not that effect upon *Snow*.

The Reason is, because *Snow* consisting of an infinite quantity of little round *Bodies*, doth reflect the *Rays* of *Light* better than any other *white Body*: For tho' in the *Night* there be but a very weak and scatter'd *Light* spread over the *Earth*; yet there is that in *Snow*, which by a stronger Reflexion of it, doth make it self visible.

IX.
What is
the Cause
of the great
whiteness
that is in
Snow, and
why the
same is
changed
when wa-
ter is cast
upon it.

An extraordinary *whiteness* is proper to *Snow*, which yet it loseth, when mixed with *water*, and returns to *water*, whence it proceeded at first.

The Reason is, because *Snow* is like a *Vapour* turn'd into *Froth*, the Flocks whereof consisting of innumerable *Globuli*, reflect the *Light* every way; forasmuch as there is never a Point in all those *Globuli*, from which *Rays* are not reflected to every Point of the *Medium*. And this is the Reason why *Snow* is hurtful to the *Eye-sight*, because that by reason of the foresaid *Globuli*, it darts forth on all sides a fuller and stronger *light*. Hence it is, that when we come into a House, after we have walked through *Fields* cover'd with *Snow*, we cannot well discern the *Objects* we meet with. It is also found by Experience, that those who live in places that abound with *Snow*, have weak *Eyes*; and some tell us, That *Souldiers*, by long Marches through places cover'd with *Snow*, have lost their *Sight*.

X.
How the
Snow comes
to change
its colour.

But if the new fallen *Snow* seems to be of a blackish Colour, the Reason is, because some Cavities are interspersed between the flocks, which swallow up the *Rays*, and do not rebound them back into the *Air*. But *Snow* wholly changeth its colour, when mingled with *water*, which filling up the Cavities of the *Snow*, hinders the Reflexion or Refraction of the *Rays*, and causeth the *Light* to be modified after another manner. Hence it is that the *white Colour* of some *Fruits*, is only owing to the parts of it that are formed into *Bubbles*: For we see that *Apples*, when squeezed, lose their Colour, because these *Bubbles* being broken by this compression, hinders that Refraction which is necessary to constitute a *white Colour*, as likewise such a copious reflexion of *Rays*, as is requisite to that purpose.

XI.
Why the
handling
of Snow
makes the
Hands to
glow.

Upon the handling of *Snow*, we find our *Hands* soon after to glow and burn.

Some suppose this to be done by an *Antiperistasis*, because when the *Cold* is driven out, *Heat* is introduc'd. But we own no such Contrariety in *Nature*, and therefore rather conclude, that this *Heat* proceeds from the *Frozen particles* of *Snow*, which having the watry humour for their *Vehicle*, do enter into the pores of the *Hand*, beat back the *Blood*, and hinder it from being dispersed through the *Veins* in the *Hands*; by which means the *Hands* swell, and appear of a red Colour. And therefore if we chance to put them to the *Fire*, we are sensible of a very sharp pricking and shooting pain; for the *Fire* being forceably thrust into their pores, doth dilate the *Icy particles* more than ordinary, and doth not drive them thence, without some twitching of the parts. Wherefore we ought to keep our *Hands* in a moderate warmth, to grow hot by degrees, and so be restored to their former condition.

Snow, tho' it be a *Frozen-water*, yet doth warm the *Earth*, and keeps the *Corn* from freezing.

XII.
Snow pre-
serves the
Corn in
the Ground
from being
frozen.

The Reason is, because the pores of *Corn*, that is cover'd with *Snow*, having been drawn together by the fore-going *Frost*, and the Matter of the 2d Element, endeavouring to enter through them, as soon as it begins to thaw, would not fail of rending the Texture of its parts, if it were not hindered by the presence of the *Snow*, which having nothing in its pores, besides the most subtil matter of the 2d Element, can easily open again the pores of the *Wheat* by degrees, without tearing them, till they be open'd large enough to let the biggest Matter of the 2d Element pass through them.

Snow doth also contribute to the making of the Ground fruitful, if it lye on for some time, and be dissolved by degrees.

XIII.
How Snow
conduces
to make
the Ground
fruitful.

The Reason is, because when *Snow* covers the Ground, it keeps in the *Alimental Juice* of *Plants*, and hinders the strength of the Ground from evaporating into Steams and Exhalations. And therefore *Countrymen* tell us, that their *Grounds* yield a more abundant Increase, after they have been a long time cover'd with *Snow*, because it keeps back those fat Exhalations, which would otherwise break forth, and turns them into *Aliment* for the *Fruits* of the *Earth*. Or, it may be said, that the *Snow* melting by degrees, doth afford a fat and cherishing *Moisture* to the *Plants*; whereby they are fed, and become more vigorous. As is manifest when the *Snow* is thaw'd, and the *Earth* expos'd again to the heat of the *Sun*; and therefore it frequently happens, that in those *Mountains* that are cover'd with *Snow*, the Exhalations that break forth, do make a kind of *Arch* or *Crust*, under which the *Grass* springs forth very thick.

I know well, that some *Physicians* are of another Opinion, who order *Gardiners*, to cover the surface of the Ground, in which *Plants* are set, with *Stubble* or *Straw*, to preserve it from the injury of the *Snow*: But I suppose they do not give these Instructions, because they suppose the *Snow* to be prejudicial thereunto, but lest the *Roots* being thoroughly moistned by the thawing of the *Snow*, a sharp *Cold* or *Frost* following upon it, might freeze the *Juice* within their pores; since it is evident, that the *Roots* of *Plants* thoroughly soak'd therewith, do presently dye; nothing being more hurtful to *Plants*, than melted *Ice* or *Snow*, to chil and kill the *Roots* after a cold Thaw.

XIV.
How Snow
may be
hurtful to
the Roots
of Plants.

CHAP. VI.

Of the Dew, Hoar-frost, Honey and Manna.

The Dew is observed to be more copious in moist and moorish Places, than in dry. Hence it is that the Banks of Rivers are commonly cover'd with Dew, when in dry and barren places there is no appearance of it.

The Reason hereof is commonly ascribed to the Vapours which mount up from the Earth in great abundance, about the Banks of Rivers, and being

I.
Why the
Dew is
more cop-
ious in
moist, than
in dry
places.

raised a little way up into the Air, do fall down to the same place whence first they broke forth. But I cannot altogether concur with this Opinion; forasmuch as the highest Mountains are in the Summer moistened with Dew, and in the Winter covered with Hoar-frost. For Vapours are not only condensed near the Earth, but also on high in the Air: For those which are carried up a great height by the Sun's force, are afterwards by the cold of the Night condensed and turned to Dew. And whereas Shoars are more abundantly covered with moisture at Break-of-Day, than other more dry places; the Reason is, because the dry Earth drinks up the Drops of Dew as fast as they come down upon it, and does not suffer them to be condensed on the surface of the Ground. But Shoars, or the Banks of Rivers being, as it were, glutted with moisture, do not take in the Dew, but leave it on the surface. Thus the drops of Dew run together upon Cabbage-Leaves, because their surface is somewhat fat and oily; but are immediately drunk up, when they light upon Sand.

II.
Why the Dew is more copious in the Spring and Autumn, than at other times.

The Dew is observed to fall more copiously in the Spring and Autumn, than in the Winter or Summer.

The Reason is, because in the 2 former Seasons, the heat of the Sun is strong enough to raise Vapours, and the cold of the Night sufficient to condense them; whereas in the Winter, the Plants being deprived of their Leaves, are no longer able to turn the Vapours that light upon them, into little drops: And the heat is so violent in the Summer, that the Vapours can't be sufficiently condensed, by the cold of the Night, to fall down again into small drops.

III.
Why the Drops of Dew are round.

The drops of Dew are Round, or at least resemble the figure of an Hemisphere.

The Reason is, the motion of the particles of the 2d Element, which equally pushing upon all the parts of the drops of Dew, makes them to be equally distant from the Center. For as the water of a River running freely through the Herbs it meets with in its course, is so diverted by the Stones that interrupt its Current, that re-bounding upon it self, it makes several little Whirl pools: So the Globuli of the 2d Element, freely flowing through the Earthy parts wherewith they are interrupted, their fluid parts are so diverted by the Air that meets them, that turning into a Round drop, they drive the Terrestrial parts of the said Drop, with an equal force towards the Center. For then any liquid Body becomes round, when all the parts of the Circumference of that Body, being driven with equal force, are at an equal distance from the Center of that Body.

IV.
When no Dew is found upon the Ground in the Morning, it is a sign of Rain.

If in the Morning the Ground be not sprinkled with the Dew; and that the Mist which is wont to moisten the Earth, is carried upwards, and leaves the Earth wholly dry, this is a sign of Rain.

The Reason is, because this can scarce happen, but when the Earth hath not been sufficiently cooled in the Night, or over-heated in the Morning, and therefore sends forth many Vapours, which driving the Mist upwards, cause the Drops of it to run together, and by this means become so thick and heavy, that soon after they are forced to fall down in Rain.

The Hoar-Frost is observed to make some Herbs more tender, as Coleworts, and the like, which being in Winter expos'd to the Air, become more short and tender.

V.
Why the Hoar-frost makes some Herbs more tender.

The Reason is, because the supervening Cold doth constringe, and, as it were, draw together those Herbs, and by bringing together their particles nearer to one another, doth quite change the order and situation of them. So as that having already undergone this preparatory Alteration, when the Culinary fire begins to act upon them, their Texture is easily broken, and their Fibres being before lessened, and in part dissolved, are wholly separated from one another. Thus Flesh, exposed to the cold of the Night, becomes also more tender, because the parts of it being more closely joyned and drawn together by the cold are afterwards slackned by the heat, and more readily comply with its motions.

The parts of Hoar-Frost stick together; the contrary of which we Experience in Hail; which is distinguish'd into several Stones, which have no Connexion at all together.

VI.
Why the parts of Hoar-frost hang together.

The Reason is, because Hail-Stones falling from on high, as soon as they are come to the inward Tract of the Air, because of the great heat they meet with there, their outsidest begin to melt, and lose their prominent particles, which make them rough; but the case is not so with the Hoar-Frost, which always retains its sharp-pointed protuberances; and therefore the particles, by reason of this their Roughness, are easily entangled and cling together. To which may be added, That the Hoar-frost consists of a more viscid or clammy substance, than Hail; because the Rain, whereof Hail is made, is meer Water, which presently mounts up into the Air: Whereas the Hoar-frost is a kind of condensed Dew, which is much fatter than the Rain, as being made up of diverse particles, proceeding from Animals, Plants, and Things dug out of the Ground. Now it is manifest, that a moisture that is extracted from such great variety of Bodies, must needs be more clammy, than a pure watry Humour; which is the reason why the parts of Hoar-frost cling together, whereas Hail-stones are all several.

Those who give their minds to Husbandry, and more diligently search into the Miracles of Nature, observe that Bees do in a very short time make Honey, and fill their Hives. Some, who have been very exact Observers of the Labour of Bees, have observed, that the Bee-Hives are sometimes quite Empty in the beginning of May, and within a short time after have found them fill'd up with Honey.

VII.
How Honey is made by Bees.

It is not yet certainly known, whether the Bees draw that Juice out of Flowers, which of it self is presently turned into Honey; or whether they themselves, by an inborn Natural property, do transmute the said Juice into such a Taste, and other Qualities, as constitute Honey. Some are of Opinion, that Bees have not the Faculty to make Honey, but only the skill of gathering it. Whereas others suppose them endued with a Virtue or Faculty, whereby they turn the Juice they suck from Flowers into Honey. And I readily agree with those that are of this latter Opinion; for I find that Animals transmute the residue of their Aliment into Milk, in their Breasts, whereby it becomes changed





changed into a new kind of Substance. And why may not the *Bees*, in the same manner, after that their *Bodies* have been nourished with some part of the *Aliment*, transmute the Remainder of it into *Honey*, which they daily hoard up in their *Hives*. It is a difficult thing to find by Experience, whether they cast up the *Juice*, which they draw from *Flowers*, through their *Mouths*, or evacuate it from any other part; tho' it seem more consonant to Reason, that they evacuate it backwards, especially if it be elaborated in their *Stomachs*. Neither doth it hinder the Truth of this Assertion, that *Bees* very greedily lick up the *Honey* they meet with in any place, and leaving their *Flowers*, betake themselves to it; because they desire it as their proper *Food*, wherewith they are sustained, and which, when they have lick'd in; they do convert again into other *Honey*. As *Women* that give Suck to *Children*, do also take in *Milk* for their Nourishment, and after it hath been digested in their *Stomachs*, do in their *Breasts*, turn it into a new sort of *Milk*.

III. Tho' *Honey* be made of *Dew*, yet is it not gather'd either by *Bees*, or *Men*, from *Plants*, in all places.

The Reason is, because these *Exhalations* do not every where meet with such a disposition, as is proper to retain them; for seeing that the most clammy and *Earthy particles* of the *Dew*, are the chief Matter of *Honey*, and that these can only be gather'd in *dry places*, we cannot think it strange that these are not found on the moist *Leaves* of some *Plants*. Hence it is that *Bees* do not gather their *Honey* very Early in the *Morning*, but after that the *warm Vapours* have been dispersed by the heat of the *Sun*.

IX. *Manna* is very different, according to the Countries where it falls, and is only gather'd from the *Leaves* of some certain sort of *Trees*. *PLINY*'s Opinion is, that it is most commonly coagulated upon *Oaks* or *Lime-Trees*. In *Calabria*, it is chiefly found on *Ash-Trees*, and in *Syria*, on *Cedars*.

The Reason is, because *Manna* is only coagulated on the *Leaves* of *Trees*, which contribute much to its consistence and hardness. For seeing that *Manna* only consists of *Exhalations*, its particles are of such figures, that they cannot so well stick close to the *Leaves* of other *Trees*. And therefore the Lord *BACON* tells us, that the Country of *Calabria* affords the best *Manna*, and in the greatest plenty; for he supposes, that there is a kind of Coagulating virtue in the *Leaves* of *Mulberry-Trees*, on which it is commonly gather'd, whereby the *Dew* is thickned. Which *Virtue* he is the rather inclin'd to attribute to the *Mulberry-Leaves*, because they are rough and hairy, and therefore very proper to retain a *Liquor* that lights upon them. But yet this *Juice* must not be confounded with *Honey*, forasmuch as it is of a different Nature, and different Efficacy: For *Honey* doth stimulate and increase *Gall*, whereas *Manna* drives it out of the *Body*; for the *Nitrous Salt*, which *Manna* is not destitute of, doth provoke Nature to evacuate by *Siege*.

CHAP. VII.

Of Storms and Thunder.

The same Storms rage more violently on the Sea, than on the Land.

The Reason is, because the *Vapours* that are sublimed from the *Waters*, are more moist and gross, than those that breath forth from the *Earth*, and that proceed from *dry Bodies*. Hence it is that those *Steams* carrying more *Air* and *Exhalations* along with them, do furnish Matter for the strongest *Winds*. And for the same Reason it is, that *Winds* in all places are not endued with the same Qualities; but those which are dry in one Country, may be moist in another. Thus it is observed, that *South-winds*, which generally in all places are moist, yet are dry in *Egypt*, where the dry *Desarts* of *Africa*, parch'd with heat, and destitute of all moisture, supply the Matter of them.

Swallows, upon the approach of a Storm, fly near the *Earth*.

The Reason is, because the *Clouds* which then fall lower, and press down the intervening *Bodies* with their weight, drive the *Flies*, which *Swallows* feed upon towards the *Earth*, which in *Fair-weather* are wont to fly aloft in the *Air*.

The *Sea* doth never Rage more dangerously, than in those Storms which are called by the *Portuguese*, *Travados*, these of all other being most formidable to *Sea-men*.

These *Tempestuous Gusts* are chiefly perceived beyond the *Cape of Good-Hope*, because there, the *Vapours*, which in great quantity are raised from the *Sea* of *Ethiopia* (as being of a vast extent, and exposed to the greatest heats of the *Sun*), can easily produce a *West-wind*, and stop the violence of those *Vapours*, which proceed from the *Indian-Sea* that is opposite to it; and by this means drive them together into a *Cloud*: Which *Cloud*, since it riseth from the Inequality that is interposed between those two great *Seas*, and this Tract of *Earth*, which is also of a vast breadth, must of necessity be of a greater bulk, than that which is formed in our *Regions*, where it depends only on those lesser Inequalities, which divide our *Champion Countries*, and separate *Lakes* and *Mountains*: So that this high *Cloud*, having acquir'd a great weight, doth fall down all together, and driving the *Air* before it, raiseth a great *Tempest*, which commonly is so much the more vehement, the lesser the *Cloud* did appear at first; because it is supposed to be very high, and at a greater distance from the *Earth*. Now it is evident, that the force of a *Ponderous Body*, is by so much the stronger, by how much higher the place is whence it descends, and the greater the Space is it runs through.

These Storms are frequent about the *Equator*, especially in those Months in which constant *Winds* are less frequent. They are very common upon the Coast of *Guinea*, and at the first their Force is very violent, and by the help of them *Sea-men* often pass the *Line*, forasmuch as the settled *Winds* are now and then wanting in the Months of *April*, *May* and *June*, and also at other times. Wonderful Storms of this kind do also happen in the Entrance

I. Storms at Sea are more violent than about the Shore.

II. Why Swallows, upon the approach of a Storm or Tempest, fly near the Earth.

III. What is the reason of those dreadful Storms called Travados.

IV. In what Places these Tempests are most frequent.

france of the Sea of *Arabia*, when a thick and black *Cloud*, mixed with a number of *Flame-colour'd* little *Clouds*, like a *Burning-Furnace*, vomiting thick *Smoak*, darkens the *Day*, whereupon a sudden and most vehement (but not long lasting) *Storm* ariseth, which casts down a great quantity of red *Sand* upon the *Land* and *Sea*.

In the *Gulf* of *Lions* the *Waters* are sometimes as much agitated, as in the most violent *Storms*, tho' the *Air* be very calm.

This extraordinary Agitation proceeds from those *Vapours*, which penetrate quite through the *Waters*. For it cannot be question'd, but that there is an inward *Heat* at work under the *Sea*, besides that of the *Sun*, which loosens, or sets at liberty a vast number of *Vapours* and *Exhalations*, which proceed with extraordinary precipitancy, and in great abundance from the said *Gulf* of *Lions*. And from the same Cause we may deduce the Boiling or Agitation that is observed in the *River Garonne* in *France*, near to *Bordeaux*, which is an infallible prognostick of a certain *Wind* called *Masquer*; and conclude it to be produc'd by *Vapours* or *Exhalations*, which ferment or work successively from *Bordeaux*, towards the Head of the *River*; as that *Ebullition* which is observed in the *Gulf* of *Lions*, is caused by the *Vapours* and *Exhalations*, which in that part mount up in great abundance through the *Sea*.

Hurricanes are very frequent in some of the *Caribby Islands*.

The Reason is, because many *sulphurous* and *Nitrous Exhalations* are sublimed from divers parts of the *Earth*, that lies below that *Sea*, which do agitate the *Waters* with that extream Violence. Whereof this is a pregnant Instance, That after every *Hurricane*, a vast number of *Fishes* are found dead; which shews, that the *Waters* have been violently dash'd together, not only on the surface of the *Sea*, but at the bottom also.

It sometimes happens in great *Storms*, that certain *Meteors*, in the appearance of *Fire*, fix themselves on the Tops of *Masts*, which are called by Sea-men *Castor* and *Pollux*, if there be two of them; but if only one appears, it is called *Helen*. The former being look'd upon to be a happy Omen; but the latter, unhappy, as portending an increase of the *Storm*.

These *Fires* are produc'd by *Exhalations*, which are mix'd with *Vapours*, that compose a *Cloud*; which, forasmuch as by reason of the solidity of their parts, and their irregular figures, they cannot be pusht forwards by the falling *Cloud*, with the same force as the *Vapours* are, by the motion of the *Air*, are separated from them: And accordingly these *Exhalations* being united into several Curles, flying as high as they can along with the *Cloud*, meeting with *Ships* in their way, stick to the *Masts*, or to the *Tackle*; the *Cloud* in approaching to the end of its motion, driving them down thither. And the Reason why two of these *Fires* are a sign of better Hope, is, because *Storms* are commonly more violent towards their going off; and therefore when these *Fires* are more than one, the *Tempests* are broken, and many *Clouds* lying one upon the top of another, are in a short time disperied. But when a single *Fire* appears, a greater *Storm* is to be look'd for, because there may be many other *Clouds* remaining, which fall-

ling down, may with renewed Violence dash the *Waves* together.

Thunder is much more frequent in *Summer* than *Winter*.

The Reason is, because *Thunder* is caused after the same manner as *Storms* are, viz. by the falling of *Clouds* one upon another, that is, when the higher *Clouds* rushing down violently upon the lower, do produce that Noise in the *Air*, we call *Thunder*. Now this could not happen, if a warm *Air* surrounding the Upper *Clouds*, did not by degrees condense them, and make them more heavy. And seeing that in the *Winter*, a heat sufficient to melt the Upper *Clouds* cannot get up so high, it is evident that *Thunder*, for this Reason, must be more frequent in *Summer*.

The Noise caused by *Thunder* is very different; and doth not always strike our Sense of *Hearing* alike; for sometimes it represents a continual Rumbling, and at other times the repeated Discharges of Great *Guns*.

The continued Noise is to be ascribed to the various Reflexion of *Bodies*, and the Resounding of the ambient *Air*. For as the Noise caus'd by the Discharge of a Great *Gun*, is heard with a continued noise or rumbling, because of the *Hills*, *Buildings*, and other things, that beat back the Sound: So the rumbling Noise of *Thunder* is continued the longer, because of the *Air* that every way surrounds it, and the *Bodies* that are so disposed to reverberate it. And whereas *Thunder* sometimes gives different and interrupted Claps, the Reason is, because the parts of the higher *Clouds*, do either all of them fall down together, or one after another; or more slowly or swiftly; or, for that the lower *Clouds* are greater or less, thicker or thinner, and so make more or less Resistance.

After a great Shower of *Rain* commonly the *Thunder* ceaseth.

The Reason is, because the Upper *Cloud* falling upon the Lower, is of such force as to cast it wholly down; and tho' perhaps it be not of force enough to drive it down altogether, yet it shakes out some flocks of *Snow*, which passing through the warmth of the lower Region of the *Air*, are turned into *Rain*. And it is for the same Reason, that Men endeavour to abate the violence of *Thunder* by the discharging of *Guns*; for the *Snow* being shaken by the agitation of the *Air*, is disscut, and forced to descend.

But we are here to observe, that tho' the Discharging of our Great *Guns* be useful to dispel *Thunder*, when the *Clouds* are somewhat remote from the places where the said Noises are made; yet is the effect quite contrary, when the *Clouds* are directly over against those places.

The Reason is, because when the *Clouds* that carry the *Thunder*, are at some considerable distance, the agitation of the *Air*, caused by the Sound is capable to disperse them, or at least to oppose their approach; but when they are just over against the places where the *Guns* are discharged, the *Air* being shaken by their Sound, and dashing against the lower part of the *Clouds*, weakens them, and so determines them to break at the bottom, and to let the *Lightning* escape.

The

V.
Whence
proceeds
that boyl-
ing of the
Waters,
which is
observed in
the Gulf
of Lions,
and in the
Garonne.

VI.
What is
the Cause
of those
Hurricanes
that hap-
pen about
the Carib-
by Isles.

VII.
Of Castor
and Pollux,
and why
they are
accounted
to be signs
of a happy
Voyage by
Sea-men.

VIII.
Why *Thun-
der* is more
frequent in
Summer,
than *Win-
ter*.

IX.
What is
the Reason
of the dif-
ferent Noise
that is
made by
Thunder.

X.
Why *Thun-
der* com-
monly
ceaseth
after a
great
shower of
Rain.

XI.
Why a
great Noise
disperies
Thunder.

To the Honoured

Sir Henry Hobart .

O F

Blickling in Norfolk, Knight and Baronet.

Sir,

THE Authors Opinion in relation to BRUTE ANIMALS, as discoursed of in this ensuing Tract, being an Opinion not commonly received; requires the Protection and Patronage of some Person, Eminent for his Learning, and one whose high Reputation may defend the Opinion against the cavelling Critick, and wrangling Disputant. For this Reason, Sir, 'tis that I have selected You from amidst the number of those Ingenious Persons, I have the honour of knowing, as reasonably believing, You who are allowed by all that are so happy to be acquainted with You, to be excelling in the ingenious performance of Learning, may, by Your favouring that Opinion, if not totally recommend it as an uncontroverted Position, yet stamp it so, as to make it currant with the Ingenious: For which Kindness and Generosity I might blush, should I not gratefully make my acknowledgment; assuring You that none would more willingly serve You to the height of his Power, than,

Sir,

Your most Humble and Devoted Servant,

Richard Blome.



Lent. 1711.

T. Kip Sculp.

XII.
Why the
Thunder is
always
heard after
the Light-
ning, tho'
indeed it be
before it.

The *Lightning* is much more swift than *Thunder*, and therefore is always seen before the other is heard, tho' indeed the *Thunder* is ever before the *Lightning*.

The Reason is, because the *Sight* is performed by the help of the *Heavenly Globuli*; which being solid, and not capable of any division, do neither waver nor turn aside: Whereas the *Hearing* is performed by the *Tremulous Agitation* of the *Air*, whose particles being very flexible, and separated from one another, do bend upon themselves and waver, not having the direct steadiness of the *Globuli* of the *Second Element*.

XIII.
Why fer-
mented Li-
quors are
apt to turn
sour after
Thunder.

The *Noise* and *Concussion* of the *Air*, caused by *Thunder*, makes *Wine* and other fermented *Liquors* to be troubled, and change their former *Qualities*.

The Reason is, because *Fluid Bodies* are not moved of themselves, but receive their agitation from the intercurrent *subtil matter*, wherefore also their motion must necessarily be proportionate to the Agitation of the said *Aethereal Matter*. And forasmuch as when the *Aether* is shaken with *Thunder*, the matter that is intercepted between the *Pores* of it, is very much dissipated, and put into irregular motions; thereupon the particles of the *Liquor* are also variously tost and bent, and by this means do introduce a confusion in it. Thus *Physicians* also observe, that tho' the *Blood* be not changed at all as to its outward appearance, yet it contracts a malignant *poisonous quality*; or on a suddain causeth a *Fever*, and this merely from the disturbed motion of the *subtil matter*, which in a confused manner agitates the whole mass of *Blood*.

CHAP. VIII.

Of Lightning and Thunder-Bolts.

I.
Why the
Lightning
commonly
strikes Stee-
ples and
Tall Trees.

High Places are more frequently struck with *Lightning*, than low and level *Grounds*. Hence it is that *Mountains* feel more its effects than *Valleys*; and that the tallest *Trees* are most obnoxious to be hurt by it.

The Reason is, because *Lightning* consists of kindled *Exhalations*; which because of their loose *Texture* and volatility, are distinguished from *Vapours*, and therefore rushing down towards the *Earth*, must rather strike the tops of *Steeple*s and *Mountains*, than lower places. For the *Lightning*, upon the breaking of a *Cloud*, doth commonly dart forth from that part of it, which is most weak, and least able to resist the force of it: And seeing that *Steeple*s, *Rocks*, *Mountains* and other *Eminences* do most of all oppose it, therefore the *Clouds* are most easily broken by meeting with such like *Bodies*, and consequently also discharge their force and violence against them.

II.
Why the
Bodies that
are struck
with Light-
ning, do
tremble
a little be-
fore.

Things that are struck with *Lightning*, do tremble before they are smitten, being shaken by the *Wind*.

The Reason is, because when ever this *Fiery Exhalation* is darted from any *Cloud*, at the same time a great quantity of the *Air* that lies between the *Clouds*, is pushed away together with it: Which *Air*, as the Forerunner of the *Lightning*, shakes high *Steeple*s, lofty *Mountains* and tall *Trees*, as being nearer to it, before the *Lightning* can reach them.

Sometimes there is a *Stone* generated by the *Lightning*, which is discharged together with it from the *Clouds*, which is commonly called the *Thunder-Bolt*; because it breaks all *Bodies* it meets with, and casts them down.

This happens when many *Fat* and *Sulphureous Exhalations*, consisting of thick and dreggy parts, and like unto the settling of those *Vessels* wherein *Rain water* hath stood for some considerable time, are joined with those that form the *Lightning*. For as Experience informs us, that if we mix a certain proportion of *Saltpeter* and *Brimstone* with this *Earth* or *Mud*; and then set this mixture on fire, it will in a moment be turned into a hard *Stone*: So in like manner we may conclude, that a *Thunder-Bolt* is generated of clammy and *Terrestrial Exhalations*, mingled with *Brimstone*, which it may meet with, either in the *Cloud* it self, or in its descent through the *Air*. Wherefore sometimes not only *Stones* are thus hurled down together with the *Lightning*, but also *Iron*, and other metals. *AGRICOLA* tells us, lib. 5. de *Ortu Subterraneorum*, that when it lightens in *Persia*, pieces of *Brass* fall down, which will not melt in the hottest *Furnaces*, but the moisture of them is turned into *Smoke*, and the rest of the Body into *Asbes*.

But for all this, some think there is reason enough for us to look upon this Story of *Stones*, that are together with the *Lightning* discharged from the *Clouds*, as a meer fiction. Certain it is, that none of the *Ancients* ever made mention of it before *AVICENNA*: And it seems very strange, that if there be any such, none of them should ever be found in great Cities, such as *London* or *Paris*.

Gold, *Copper* and *Silver* are by the *Lightning* melted in *Peoples Pockets*, without the least scorching of them: And the *Wine* that is kept in *Barrels* is consumed, without the least sign of hurt done to the *Vessels*. And *MARCIA*, a *Roman Princess*, being struck with *Lightning* when she was big with *Child*, had the *Birth* in her *Womb* killed without suffering the least hurt her self. *Pliny*, lib. 2. Cap. 51.

These strange effects must be ascribed to the various matter whereof the *Lightning* consists. For some consist of very subtil *Exhalations*, which are of the nature of *Volatil Salt*, or approach to that of *Aqua Fortis*. Now such as these do not touch loose and soft *Bodies*, but break and dissolve those that are solid and compact, and do resist their force. And therefore no wonder if such sort of *Lightning* do melt *Brass*, *Silver* and *Gold* without touching the *Purse* or *Bag* wherein they are: As we see that *Aqua-Fortis* doth not corrode *Wax*, tho' in a very short time it dissolves *Iron*, and other hard *metallick Bodies*. Whereof *SENECA* gives this Reason in Chap. 52. of his *Natural Questions*. The *Lightning*, saith he, doth dissipate strong and solid *Bodies* with more vehemence, because they oppose a greater resistance to it; whereas it frequently passeth yielding substances, without the least hurt to them: It contends with *Stones*, *Iron*, and other very hard and solid *Bodies*, because it cannot make its way through them but by force; and therefore by extrem *violence* opens it self a passage whereby it may get out. But on the other hand, spares loose and soft

III.
What is the
cause of the
Stone,
which is
produced by
Lightning,
and is com-
monly call'd
the Thun-
der Bolt.

IV.
There is
some reason
to question
the truth of
these Thun-
der Bolts.

V.
How the
Lightning
can melt
Gold in a
Purse, and
consume
Wine in a
Barrel,
without
hurting ei-
ther the
Purse or
Barrel.

Bodies, tho' they seem the most proper for its Flames to fasten upon, because they let it pass without opposition.

VI.
How the Lightning sometimes strikes the Vessels without touching them.

As to the Lightning consuming Wine, without touching the Vessel; the Reason is, because the most subtil matter, passing through the Pores of the Vessel, by its most swift and violent agitation, doth so diminish the parts of the Wine, and reduceth them to that extream littleness, that they can freely pass through the pores of the Vessel. By which means the Wine being wholly turned into Vapours, is in a short time thrust through the sides of the Vessel. Wherefore some, to prevent this disaster, lay a Bar of Iron with Flints and Salt upon the Vessel, which being hard Bodies, the Lightning exerts all its force upon them, and so the Wine or other Liquor in the Vessel escapes without hurt.

VII.
How Beer or Ale may be preserved from being spoiled by Lightning.

Accordingly Mr. BOYLE assures us, that having seal'd up a Glass Bottle Hermetically, which he had fill'd with Beer; he found upon the opening, that the Thunder had not in the least changed the Taste, or any other of its Qualities; when at the same time that which was kept in Vessels was all turn'd sour.

The Reason is, because the Exhalations that constitute the Lightning, being diffused through the Air, do penetrate the Vessels, but not the Glass. He also tells us, that when Smiths Coals are kindled in Wine-Cellars, when it Thunders and Lightens, it preserves the Beer from turning sour; and this either because the Fire doth dispel and discuss those Sulphureous Exhalations, or because it dulls the force of them, by changing the Figure, Magnitude or Texture of the particles whereof the said Steams do consist.

VIII.
How a Woman may have the Birth in her Womb killed by Lightning, without any hurt to her self.

As to the Story of MARCIA, who being struck with Lightning, brought forth a dead Child; this effect needs not to be attributed to the Power of Lightning, since probably it might be only the effect of her Fear; who being affrighted at the Lightning, miscarried thereupon. Or if we will suppose that she was struck with Lightning, the cause why it killed the Infant in her Womb, without hurting of her, might be, because the Exhalations, whereof that Lightning did consist, was of an Oily Nature, and burning only with a weak Flame, could only exert its force upon the weak and tender Body of the Infant, without touching the Mothers Body, which was more hard and solid. For so we find that Lightning sometimes consumes soft and tender Bodies, without hurting those that are more strong and solid; as the Hair, Cloaths, and the like, without any injury done to the Flesh: And that because the particles of the Exhalation, that form the Lightning, are like those of Spirit of Wine, which when set on fire do not touch a piece of Linnen so as to consume it, as being too weak and slender to separate the particles of the Earthly Bodies they meet with from others that are like to them, or from those of the 2d. Element.

IX.
How Animals are kill'd by Lightning.

These Exhalations are also supposed the cause of the death of some Animals, found dead without the least sign of Burning or Scorching. For by the violence of these Exhalations, Animals may be so overpowered, as that thereby their Muscles design'd for Respiration may grow stiff

and without motion; whereupon, no wonder if they be presently choaked. For these Exhalations may be so extreamly subtil and pure, as to be able readily to enter the Body, and hurt the inward parts of it, without the least sign of damage appearing upon the outward parts thereof.

Nothing is more commonly received amongst Ancient Authors, than that a Bay-tree is never toucht with Lightning, as being endued with a peculiar virtue, which resists and repels its deleterious Spirits. It was for this Reason that the Emperor TIBERIUS wore a Crown of Bay-leaves, when the face of the Sky seemed to threaten Thunder and Lightning. And COLUMELLA adviseth to cover the Eggs on which a Hen sits with twigs of the Bay-tree.

Some attribute this virtue of the Bay-tree, to the figure of it, which is very round, and hath a very smooth and close Bark: From whence they infer, that the Exhalations of the Lightning cannot fix upon it, but gliding from it, leave it untoucht. But this seems to be but a very weak Reason, forasmuch as Marble Pillars, which for Roundness and Hardness do far exceed the Trunk or Body of the Bay-tree, are frequently struck with Lightning, and damaged by it; as CARDAN assures us, Subtil. lib. 2. At Florence in the Great Church is to be seen a Marble Pillar, struck and hurt with the Lightning. For I suppose it to be a meer Fable, what is commonly reported of the Bay-tree; seeing that many Authors do assert, that Bay-trees have been sometimes struck with Lightning; as amongst others the Conimbricenses, and Vicomercatus in his Comentaries upon Aristotles Treatise of Meteors, by several instances proves the exemption of the Bay-tree from being hurt by Lightning, to be fabulous. The Reason probably why the Ancients attributed this virtue thereunto might be, because they abound with Balsamick, Odoriferous and Spirituous Steams, which may be of some force, in keeping off the efficacy of poisonous Exhalations. Tho indeed it be not at all probable, that the Leaves or Stock of the Bay-tree should be of such a superlative virtue, as to resist the force of Lightning, or to secure those that shelter themselves under its Branches, or wear the Leaves of it. And the same may be said of Coral, whatsoever PLINY saith to the contrary, Lib. cap. 55.

Authors assure us, that Sea-Calves are never struck with Lightning; and for this Reason the Generals Tents were used to be made of the Skins of this Animal. And SÆTONTIUS tells, that AUGUSTUS CÆSAR was so afraid of Lightning, that he always had some of them along with him in his marches.

Some attribute this virtue to the loose Texture of the Skins of these Creatures, because the Lightning pierceth through the Pores of them, without doing any hurt. But this Reason is not solid enough to prove such an extraordinary virtue to reside in these Skins. For how can that person be said to be exempt from the force of Lightning, who is covered with these Skins, if it can so easily pass through the open Pores, and loose Texture of them? Wherefore I am most apt to believe that this virtue was attributed to the Skin of Sea-Calves, because of the wonderful Sympathy they have with the Sea; for the Hairs of this Animal stare and

X.
Whether the Bay-tree be never struck with Lightning.

XI.
Whether a Sea-Calf can never be hurt with Lightning.

Bristle,



Brittle, when the *Sea* is tempest, and lifted up into Waves; but lie flat and smooth when a Calm returns. And therefore *Seamen* were used to carry these *Skins* along with them, to foreknow the changes of the *Weather*, and to provide for them; which afterwards may have given occasion to some to imagine that these *Skins* were of sovereign use against *Storms* and *Lightning*, and that the *Tents* which were covered with them, were exempt from the stroke thereof.

CHAP. IX.

Of the Rainbow.

I. The Primary or Original Rainbow is of more strong and lively Colours than the Secondary.

THE Primary or Original Rainbow, and which for the most part doth appear alone, is of more strong and sprightly Colours, than the Secondary, which is seen above the former; whose Colours are not only weaker, but also appear in an opposite situation to those of the Primary Rainbow.

The Reason hereof are the *Rays*, which from both these Rainbows arrive at the Eye. For they which proceed from the Primary and Interior, as in a *Glass Viol* arrive at our Eye after two Refractions and one Reflexion. And therefore the Rays meet under the same Angle they make with the common Axis, in the same point of the Eye, from the same base of the Cone. But the more outward or Secondary Rainbow is produced because the Beams that fall upon the lowest quarter of the drops, get out from them and reach the Eye after two Refractions, and as many Reflexions; which makes the Red, Yellow and Green Colours with all the rest, that are very conspicuous in the Primary Rainbow, to be very weak, and exhibited in an inverted posture, in the outward or secondary. Forasmuch as the Rays, which after two Refractions and one Reflexion, leave a lesser Angle of Elevation, when another Reflexion is added, will make a greater; and on the contrary those which made a greater, for the most part, at least, will make a lesser.

The two ends of a Rainbow appear unequally distant.

This happens when the Rain is bounded on that side where the Spectator stands on a Plain so inclined to the Axis of Vision, as to make an Acute Angle towards the Left Hand, and an Obtuse one towards the Right: For then it is necessary that the Conical Figure which determines the drops that we must see coloured, do meet with them in such a manner, as that those which are on the Left, be much nearer to the Eye of the Spectator, or to the Axis of the Vision, than those which are on the Right Hand: And because these two sorts of Drops do form the two ends of the Rainbow, therefore it is that they appear at an unequal distance: And if we have a mind to fix the center of this Rainbow, in a point equally distant from both the ends of it, then must they of necessity meet without the Axis of Sight or Vision.

Some tell us, that they have seen a Rainbow, with the ends of it turned upwards towards Heaven, as the same represented in the Figure by FFF.

Many suppose this to be no better than a Dream or Imagination: Yet for my part, I cannot see but

that the thing may be possible enough; that is, when the Rays of the Sun by Reflexion, light upon the surface of some Sea or Lake; and this at a time when there is a great Calm, without the least breeze of Wind to wrinkle the Water. Especially if at the same time a Cloud, such as is represented by G, do lie over the said Water, and hinder the Light of the Sun, directly tending towards that part of Heaven where the Rain is, from suppressing or extinguishing that Light, which the water sends back thither. True it is, that such Rainbows as these are seen but very seldom: But it is not therefore presently to be rejected as an Imagination, because there are but few that ever saw such a one. It is sufficient, if ever it was seen, to make us enquire into the cause of it.

Let us suppose therefore, that the Sun Beams, proceeding from that part of the Heaven, marked S S, fall upon the water D A E, and from thence rebound to the Rain C F, the Eye placed in B, will see the Rainbow F F, whose Center is in the point C. so as that when the Line C B. is drawn out further to A, and A S, passing through the Center of the Sun, the Angles S A D, and B A E, be equal, and the Angle C B F, of about 42 Degrees. Yet may the Eye be so placed, with respect to the Sun and Rain, as to behold only the lower part of the Circle, which makes up the whole Rainbow, without seeing the upper part; and so may make us to take it for an inverted Rainbow, tho it be then beheld, not by those that look towards the Heaven, but by those that look towards the Earth or Water.

The Rainbow is commonly looked upon to be a certain sign of Rain.

Tho' this be commonly received by Philosophers as an undoubted truth, yet cannot it be universally admitted, forasmuch as experience shews us, that Fair Weather follows after the appearance of a Rainbow, as well as Rainy Weather. For tho' the Cloud, in which it is represented, be Dewy and big with Rain, yet may the Temper of the Air be such at that time, that all the water that is contained in it may be evaporated, and by the heat of the Sun, vanish away into the Air: Which being so, it will not seem strange to any, if no Rain should follow upon it, but Fair Weather. Whence it is Evident, that it is not generally true what Aristotle asserts, that a Rainbow that begins presently after Noon, doth always bring copious Showers; but that which appears about Sun-set, doth only threaten some small sprinklings, rather than any great Rain. Seeing that these signs do often fail, and that Rainbows appearing in the Afternoon, are sometimes followed by Fair Weather; and on the contrary, those that are seen about Sun set are accompanied with great Showers. And therefore I am more inclined to be of Pliny's opinion in this case, who saith, that frequent Rainbows do not with any certainty portend either Rain or Fair Weather.

Sometimes three Rainbows have been seen at a time, so as that the third supervening, hath encompassed the two common ones, but withall hath appeared paler, and less strong and refulgent than the other, and at the same distance from the 2d. as the 2d. was from the 1st.

The appearance of this 3d. Rainbow, is caused by the Hail that is mingled with the Dewy or Rainy

Figure 25.

IV. The Explanation of an inverted Rainbow.

V. Why the Rainbow is a sign of Rain.

VI. What is the Reason why sometimes three Rainbows have been seen at one time.

II. Why the ends of a Rainbow appear sometimes at an unequal distance.

III. Whether ever any inverted Rainbows do appear.

Rainy Cloud. For seeing that the *Hailstones* are round and transparent, and that a greater *Refraction* is produced in them, than there is in the *Air*, the outward *Rainbow* must needs be much greater, and so appear above, and surrounding the other. And the inmost, which for the same reason must have been much less than the middlemost of *Rain*, may by reason of the great Brightness of the former, have altogether lost its appearance, so as that both of them may have been taken for one; but yet for such a one, the *Colours* whereof were otherwise placed than in the Ordinary or Common *Rainbow*. Wherefore the 3d. *Rainbow* agrees with the *Primary*, because it is formed by *Rays* falling on the upper part of the *Drops*, and therefore do both of them represent their *Colours* in the same order, save only that in the 2d. the *Colour* does by degrees grow weaker than in the 1st. and in the 3d. than in the 2d.

VII.
For the
Rainbow
affords a
Sweet Odor

The *Ancients* have observed, that a sweet *Odor* is perceived in all places whither the *Rainbow* inclines, or which it hovers over.

The Reason is, because the soft and pleasant *Dew* of the *Rainbow* is proper to draw forth the perfume of *Odorous Bodies*. For we find that moderate *Showers* have the same effect, tho' not in so high a degree; for nothing affords to the *Ground*, or fills the whole *Air* with a sweeter fragrance, than the *Dewy Rain* of the *Rainbow*, wheresoever it falls. So that for ought we know, there may be a fragrance in the *water* it self that composeth the *Dewy Cloud*; seeing that a *Rainbow* is nothing else than drops of *water* clustered together, which cannot come down in *Rain*, but from that part of the *Air* which is near the *Earth*, and therefore more proper to imbibe and retain the fragrance of the *Herbs* and *Flowers*, like a distilled *water*. For *Rain* or any other *Dew* that falls from a great height cannot retain the sweetness which was dissipated whilst the *Exhalation* was mounting so high. And therefore *PLINY* observes, *lib. 12. cap. 24. That whatsoever Plant the Rainbow hangs over, it doth impart to the same a sweetness like to that of the Rose of Jerusalem; but to that Plant a most inexpressible fragrance.*

VIII.
The Rainbow
doth not appear
the same to
all.

The *Rainbow* appears not the same to all, but every one sees his particular *Bow*: So that as many *Bows* are represented in the *Dewy Cloud*, as there be *Eyes* directed towards it.

The Reason of this multiplicity is manifest; because the *Rays* which come to the *Eyes* of one person, do not reach the *Eyes* of another. For tho' every drop do reflect one of the *Sun's Beams*, yet the whole *Cloud* only sets forth the coloured representation of the *Rainbow*, whilst it is so posited, that it makes its *Reflexion* at a certain *Angle*: Wherefore as any approacheth nearer to the *Rainbow*, or withdraws further from it, he doth not see the self same *Bow*, but still a different one, according as the said *Angle* encreaseth by his approach to, or decreaseth by his withdrawing from it.

IX.
The Moon
sometimes
forms a
Rainbow.

The *Moon* sometimes affords the appearance of a *Rainbow*, which, *ARISTOTLE* tells us, happens only one day of the *Month*, viz. that of the *Full Moon*.

It cannot be questioned, but that the *Lunar Beams* may fall upon a *Cloud*, and exert its action

in such a manner upon every one of the drops of it, as that by *reflexion* to our *Eye*, they may represent a *Rainbow*, which is weaker indeed than that which is formed by the *Sun*, nor deckt with so great a variety of *Colours*. *BOMBACHIUS* assures us that he saw such a one at *Oxford* in the Month of *June* 1606. But whereas *ARISTOTLE* tells us, that it is only to be seen at a certain time, that I suppose to be without ground of Truth, since there are *Authors* who assure us that they have seen the same twice in the space of two years, and that on several days, and that not at the *Full Moon*, but at the *Quarters*. And *SCALIGER* in his 8th. *Exercitation*, speaks of it as a common thing in the Isle of *St. Thomas*; where he saith, *If Rain hath preceded, there is always a Rainbow formed by the Moon, the Colour whereof represents, as it were, a whitish Mist.* I myself once beheld a coloured *Lunar Rainbow* in *England*, near *Hampton Court*, about the middle of *October*, when the *Moon* was at her *Quarter*; and had *Sir Charles Waldegrave* for a witness of this unusual sight, and who was not a little surprized to see such a one in the Night. For it appeared so plain, and with such distinct *Colours*, that it was very like a *Solar Rainbow*, save only that the representation of it was not so strong and resplendent.

It happens sometimes that we see circles of the colour of the *Rainbow* about *Lamps* and *Candles*. Such as are in the *Figure* represented by the Letters *AB, CD*, more especially after that any one hath for some time kept one of his *Eyes* shut.

X.
How Circles
come to be
formed about
Candles.

There are some who attribute this effect to the *Air* that compasseth the *Candle*, which by its thickness reflects the *Rays*, and transverts them. But that this is a mistake, is most evident from hence, because this *Circle* is not seen by all, which must be in case it were an effect of the thickness of the *Air*. We shall therefore easily apprehend the manner of the forming of it, by discovering the cause of the *Transverse* or *Cross Rays*, which sometimes appear there. Which I say then happen, when there are one or two little wrinkles in any one of the surfaces of the *Coats* or *Membrans* of the *Eye* *EM P*, which because of the *Figure* of the *Eye* *F O, S M N*, we'll suppose to be circular, and have their *Center* in the *Line* *E O*; as frequently there be there others also extended according to the *Right Lines*, which disscussate or intersect one another in this *Line* *E O*, and make us see some great *Rays* scattered this way and that way, about the burning *Candles*; and this notwithstanding, any *Opake Body* might intervene, either betwixt *E* and *P*, or elsewhere on the side, as long as it doth but circularly diffuse it self. Or lastly, The same may happen, because the *Humours* or *Membrans* of the *Eye* have in some sort or other changed their *Temperament* or *Figure*. For it is very common with those who have sore or weak *Eyes*, to see these *Circles*, neither do they appear to all persons alike.

Figure
26.

Particularly we are here to take notice, that their outward *Rims*, represented by *A* and *C*, are for the most part *Red*, quite contrary to those which we sometimes see represented about the *Stars*. The reason whereof will evidently appear if we consider that in the production of those *Colours* whereof they consist, the *Crystalline Humour* *P N M*,

XI.
Why the
outward
Rims of
these Circles
are commonly
Red.

per-

performs the office of a *Prisme*, and the *Retina* F G F, the part of the *Linnen-cloth* that receives the *Beams* passing through the *Prisme*. But some may question, forasmuch as the *CrySTALLINE Humour* is able to perform this, why it doth not do as much to all other Objects, by representing the colours of the *Rainbow* about them? Wherefore we must take notice, that many *Rays*, from every single point of the Objects, do arrive at the several points of the *Retina*; and because some of them pass through the part N, of the *CrySTALLINE Humour*, and other of them through the part S, therefore also they act in a contrary manner upon them, and destroy one another, at least as to the production of Colours: But that here all those which come to the part of the *Retina* F G F, do only pass through the part N, of the *CrySTALLINE Humour*, and therefore that the *Rotation* which they acquire there may be felt. All which perfectly agree with those things which we have delivered in our *Institutions of Philosophy* concerning Colours.

CHAP. X.

Of Fires kindled in the Air.

I.
Why those
Meteors
called Wills
with the
Wisp, do
lead men
towards
Pools and
Rivers.

WILLS with the Wisp or Wandering Lights, do frequently lead persons to Lakes and Boggy Places; and make them fall into Precipices, or lose their way.

This effect may be explained from what we have said before concerning Winds. For seeing that more Vapours are raised in the Night from the Earth, than from the Water, this is the cause why these Wandering Lights or Fires, that follow the motion of the Air, do take their course towards Waters and Pools, because thereabouts the Air is more cool, by reason of a lesser agitation, and consequently becomes thicker and more condensate, than that which lies close upon the Earth; so that these Wandering Fires, being in a manner born up by the Wings of the Air, and complying with the motion of the same, are carried thither from the neighbouring grounds.

II.
Why these
wandering
Fires follow
those that
flee from
them, and
flee from
those that
follow them

Nothing is more commonly asserted by Philosophers, than that Wills with the Wisp do flee from those that pursue them, and follow those that flee from them. And this they prove from many Examples, as may be seen in FROMUNDUS.

The cause of this is imputed to the Air, which being light and fluid, and shaken by the agitation of the person that walks along, doth either drive them forwards, or drags them along after him, when he runs from them. For if this Meteor stand before him that walks, by his driving the Air before him, it is driven forwards, and so flees from him that follows it: But if it be behind him that walks, forasmuch as the following Air accompanies him, it also follows him fleeing from it.

III.
Why these
Fires are
much seen
about
Church-
yards and
Common-
sewers.

Wills with the Wisp are commonly seen about Churchyards, Common-sewers, Fire-vorniting Mountains, and other places where great slaughter of Men or Beasts have been made.

The Reason is, because these Wandering Fires consist of fat and viscous steams, which having no such quantity of subtil particles mixed with

them, by means whereof they might be carried upwards, do fluctuate in the lower part of the Air, and are forced, because of the cleaving tenacity of their parts, and the Earthly Matter that is mixed with them, to tend downwards by their weight, rather than mount upwards; and move especially about Church-yards, Lay-falls and such like places, as abounding with a greater quantity of Fat and Oily Particles.

We read in the Writings of the Ancients, of Fires or Flames that have been seen hanging upon the Hair of Children, and that without hurting or scorching their Hair. According as VIRGIL tells us, that this hapned to Aescanius the Son of Aeneas, Lib. 2. Aeneidos.

*Lo from Julius Crown a flaming Light
Was seen to rise, and harmless Fire did spread,
With a soft touch, and round his Temples fed.*

The cause of these flames is, when a subtil and penetrating Exhalation (such as participates of the nature of Salt) doth enter the Pores of another that is Fat and Sulphureous. This being of it self sufficient to kindle some thin and subtil flames, as well on high, as in the lower parts of the Air. For certain it is, that not only a violent agitation, but the mixture only of different Bodies, is sufficient to produce Fire. As we see in Quick-lime that is sprinkled with Water; and innumerable other Examples which daily occur to Chymists.

These Lament Flames may also be caused from a commotion of the Spirits, that rush out from the Body, and being intangled together, represent the appearance of Fire: Thus Historians tell us, that ALEXANDER the Great, in the heat of Battle, darted sparks from his Body; and that something like this hapned to the fierce Horse of the Emperour TIBERIUS, from whose Head a flame was seen to break forth. For Alexander being of a fiery complexion, and addicted to the drinking of Wine, it cannot seem strange that he sent through his Pores such Spirits as were proper to kindle flames: No more than that from TIBERIUS his Horse, when he had heated himself with running, a fat and viscous sweat did break forth, which kindled into a flame, but such a one as was harmless, and without any burning or scorching quality. In like manner as the flame of Spirit of Wine, which hath some aqueous particles mixt with it, doth not burn the Linnen Cloth that is moistned with them.

And it is for the same reason, that when we rub a Cats back contrary to the hair, especially in the Winter, sparks of fire dart forth from it, because Cats in the Winter are fatter than in the Summer, and therefore are able to furnish a greater quantity of a fat clammy humour, proper for the exciting of these Sparks. But because in the Summer these steams do more easily break forth into the Air, and are dispersed there, it cannot seem strange, that when the proper matter for the generating of these Sparks fail, they should cease also, and not then appear upon the rubbing of the Cats back.

IV.
What is the
cause of
these
Flames
that some-
times ap-
pear about,
or upon the
Hair of
Children.

V.
These
Flames may
also proceed
from a Com-
motion of
the Spirits.

VI.
Why sparks
of Fire pro-
ceed from a
Cats Back
when rub'd.

VII.
What Fall-
ing Stars
are.

In clear Nights, Stars seem to shoot or fall from the Sky.

The cause is, when after a very hot and dry season, the space which is between two Clouds, is filled with copious Exhalations, that are very subtil, and proper to take fire: For if these be so light and loose of Texture, that one of them falling from on high, doth not produce any noise of Thunder, nor cause any Tempest in the Air, yet the Exhalations lying between the said Clouds, may be so twisted together, as to exhibit the appearance of some lesser flames, which are commonly called falling or shooting Stars. Because by inflammation the combustible particles, which were the cause of their ascent, were thereby consumed and vanish; and therefore the Star, which at the beginning of its delagration, complied with the motion of the Air that carried it, was called a running or shooting Star; afterwards, when its more subtil parts were burnt away, falls down, because the weight of the Earthy and viscous matter, doth exceed the heaviness of the Air that lies under it; and then is called a falling Star. And therefore these Meteors receive a different denomination from the various specification of the kindled Exhalation. For if an Exhalation that lies at length, becomes kindled, it is called a Beam; if at the bottom it be somewhat broader, 'tis called a Pyramid; if it be broad about the midst, and small at both ends, 'tis called a flying Dragon, &c.

VIII.
Why those
Fires which
are formed
near the
Earth do
continue for
some time,
whereas
those that
are produ-
ced high in
the Air are
of no long
continuance.

Fires generated near the Earth, continue for some time; whereas those formed in the uppermost part of the Air do presently vanish.

The Reason is, because a flame doth cleave more strongly or weakly to any matter, according as the said matter is more or less close and compact. Now forasmuch as these Meteors which are formed in the upper Region of the Air, do consist of a very loose and thin matter, it is plain that their flame cannot continue long. For indeed if this matter were thick and close, it would by its own weight sink towards the Earth, and leave its former station. And therefore ARI-STOTLE in the first Book of his Meteors, supposeth them to be like that flame, which runs along the smoke or Steam of a newly put out Candle, which is apt to be kindled again by another that stands near it.

IX.
What is the
cause of the
Appearance
of Armies
in the Skies

In the Sky is sometimes represented the appearance of Armies, and Soldiers fighting. Such a Representation as this is reported to have been seen in Silesia in 1545. A Bear appeared in the East at the head of an Army, and was met by a Lion, who led an Army from the West: Between both these Armies there appeared also a most bright Star; and presently after they engaged, so that the blood seemed to drop from the Bodies of those who were wounded, and many as it were fell down dead. As these Armies were fighting, an Eagle coming from an high Rock, hovered over the Lions Army. And after the Battle was ended, the Lion shone bright in the midst of his Forces; but there was no appearance of the Bear. The place where both the Armies stood was all covered with dead bodies, and by them some old Men, venerable for their Gray Hairs. Afterwards the Lion led off his Army towards the West; who after he was got some way from the place of the

Battle, a person riding upon a white Horse, adorn'd with Trappings, returned from the Army to the place where the Battle was fought, and set a young Man armed Cap-a-pee upon that Horse, and having accompanied him some part of the way towards the East, vanished together with all the other Apparitions.

I am very well aware how greedily such stories as these are embraced by the common People, and how ready they are to lay hold of any thing, which they imagin may discover to them the knowledge of future Events. And therefore if they do but see two Clouds standing over against one another, and enterchanging some Refractions or Reflexions, this is sufficient for them to apprehend two Armies fighting, that the more bright portions of them are Soldiers in whole and bright Armour, that they hear the clashing of Arms, discharging of Musquets, &c. I my self once in a clear night in Flanders saw some Vapours scatter'd in the Air, in an unusual manner, and giving some light from them, which did so terrifie the Inhabitants, that the next day all the news was that they had seen Armies in the Air, heard the rattling of Pikes, the discharging of Musquets, the clashing of Swords and the found of Trumpets.

But because it may happen that such appearances as these may really be seen in the Air, I will here add two probable causes whence the same may proceed. The First is, That there may be in the Air various Clouds of that smallness, as that every one may exhibit the appearance of a Soldier, and rushing one upon another, may contain a sufficient quantity of Exhalations, to produce some small flashes of Lightning, and cause some sounds or noises; and so represent the fighting of Souldiers. The other is, when all these small Clouds do shine, and reverberate that light which the Lightning of some great Tempest hapning at so great a distance, as that they cannot be perceived there from the Earth, do, reflect upon them.

CHAP. XI.

Of Circles about the Sun, or Moon, and of Mock Suns.

Circles about the Sun or Moon, never appear but in fair weather, and in this are distinguished from the Rainbow, which seldom appears but in rainy weather, tho' perhaps it may not rain in that place where the Spectator is.

The Reason of this difference is, the variety of their composition. Because these Circles are not formed by the Refraction of Rays from drops of water, as the Rainbow is generated, but by that Refraction which proceeds from the little Stars or Spires of transparent Ice; and tho' these Stars do never fall from the Sky but in cold weather, and the frosty Months of the Year; yet reason convinceth us, that they are produced at any other time also: Yea, and forasmuch as they stand in need of warmth, which of white as they are at first, may make them transparent, it seems very probable that the Summer time may be the most proper for the forming of them.

Some.

X.
The Com-
mon People
very apt to
believe false
Stories as
these.

XI.
What may
be the cause
of an Army
appearing
in the
Air.

I.
Why the Cir-
cles appear
about the
Sun or
Moon but in
fair wea-
ther.

II.
What is the
cause of
double Cir-
cles.

Sometimes double *Circles* have been seen in the *Sky*, so placed as that one of them did seem to encompass the other, and to appear concentrical with it.

This is caused when two Ranks of such particles of *Ice* are placed together, so as not to exclude the *Rays* of the *Sun*: For then those *Rays* which pass through both these Ranks at the end of these little *Stars*, being almost bent as much again as those others that pass through one Rank only, will produce another coloured *Circle*, much greater in compass than the former, but less bright. So as to make two *Circles* appear, whereof the one doth encompass the other, the more outward whereof is of less lively colours than the inward.

III.
Why these
Circles are
never seen
about the
Sun or Moon
at their Ri-
sing or Set-
ting.

Circles are not usually seen about the *Sun* or *Moon*, whilst they are near to the *Horizon*, that is, when they do either rise or set.

The Reason is, because then the rays of these *Luminaries* do fall so obliquely upon the particles of *Ice*, that by reason thereof they cannot penetrate them: And consequently there can be none of those *Refractions* which are the formers of these *Circles*.

IV.
What is
the cause of
many Suns
appearing
in one Cir-
cle.

Many *Mock Suns* sometimes appear in the same *Circle*. Thus it is recorded, that in the year 1625. the King of *Poland* saw no less than six of them; and five appeared to the People of *Rome* in the year 1629. and that for four hours together.

These *Parhelia* or *Mock Suns* are formed in a *Cloud*, consisting of a continuous piece of *Ice*, the surface whereof being very even and smooth, is illustrated by the *Sun* elevated towards its *Meridian Height*, and reflects the rays it hath receiv'd against the *Snow* of the *Cloud* that doth compass it. For then the *Snow* appears to those who behold it from the *Earth*, like a great white *Circle*, wherein one *Circle* is seen by means of the rays which flow from the *Sun* directly; and the two following from their *refraction*, and the rest by the *reflexion* of them.

V.
How it
comes to
pass that
some see
more Suns
in the same
Circle than
others.

Many *Suns* appearing in the *Heavens*, are not seen alike by all; for some *Spectators* see more *Suns* in one and the same *Circle*, others less.

The Reason is, because the rays that proceed from these *Suns*, are not after the same manner conveyed to every *Spectator*; forasmuch as some may be so placed, as to see no more than two of them; and others again so as that they can see three, four or more of them, according as the place is from whence they direct their *Eyes* towards them. For the rays do not affect the *Eyes* of all *Spectators* alike; neither do those which fall upon the *Eyes* of one *Spectator*, reach those of another: Seeing it is certain, that he who moves from one place to another, doth see still other and other *Stars*; and as upon shifting places, we see other *Circles* about the *Sun* or *Moon*, so likewise different *Mock Suns*. Moreover, seeing it is certain, that either the *Earth* or *Sun* must move, it cannot be but that when the *Sun* shifts its station, or when the *Spectator* is whirld about together with the *Earth*, the *Angle* of Sight must needs be changed, and those *Stars* which he saw before, will have lost the *Latitude* under which they appeared to him at first. Whence it is that every *Spectator* sees such and such *Mock Suns*, according to the difference of the place, where he is at this or other times.

Mock Suns commonly have a long *Tail*, of a very bright and refulgent white Colour.

The cause is, either the *reflexions* which are made on the surfaces of the little *Icy Bodies* which are turned towards the *Sun*; or those contrary *refractions* which the rays suffer in passing through them: Or, it may be, from both these causes together; as seems to be confirmed by Experience in those small drops of *Rain* which are about a great *Cloud*, that hides the *Sun* from us: For we see that these little drops of *Rain*, or particles of *Snow* half melted, receive a bright whiteness, not only by the rays reflected from their surface, but also from those which by penetrating them, do suffer contrary *refractions*, that is to say, which destroy one another.

Historians assure us, that the *Sun* hath been sometimes seen at *Night*, and appeared above our *Horizon*, when yet it was certainly far under it.

The Reason of this strange appearance was this, because there were *Clouds* made up of little *Icy Stars*, placed in so high a Region of the *Air*, as that the rays of the *Sun*, then below the *Horizon*, could reach them. For if we do well consider those *reflexions* and *refractions* which two or three little *Clouds*, situate in divers places, and receiving light one from another, can produce, we shall easily apprehend how they may in the night-time exhibit a very strange and unwonted light, and cause, as it were, the *Sun* to appear above our *Horizon*, at that time when it is indeed under it; and the shadows on our *Sundials* to be nearer or farther off than they ought to be, and consequently point at another hour than it is indeed.

It is observed that the appearance of *Mock Suns* have been the fore-running signs of the revolution of *Kingdoms*, the death and murder of *Princes*. Hence it is that almost all *Meteorologists* assert, that those six *Mock Suns* which were seen by the King of *Poland*, did prognosticate the taking of *Francis I.* of *France* at the Battle of *Pavia*: And that those *Mock Suns* which appeared in the year 1157. did foretell the great dissention that hapned soon after amongst the *Electors*, in their choosing of a King of the *Romans*.

It cannot be denied but that after the appearance of *Mock Suns*, some strange and uncommon effects do frequently happen: But who will say that they proceeded from this *Meteor*, and not rather by meer accident, and without any the least reference to the same? Or shall we say that there is such a close Union and near Relation between the *Heavenly Bodies*, and the Affairs of *Mankind*, that when ever such and such *Meteors* appear, such effects must follow in the other? Sure it is that *Mock Suns* would appear, tho' no such effects were to follow; and strange things would happen in the *World*, tho' no signs in *Heaven* should usher them in. Or shall we suppose, that Nature will surcease its activity, and natural causes not unite in order to the producing of their effects; except *Kings* wage War, *People* dispatch their *Princes*, and *overturnings*, *devastations* and *slaughters* happen to *Governments*? How many *Kings* leave this world, how many *Countries* are wasted, when yet no *Mock Suns* have appeared to give any warning of these *Accidents*? If therefore after the

VI.
Why Mock
Suns have
commonly
long Tails.

VII.
What is
the cause of
the Suns be-
ing some-
times seen
at night.

VIII.
Whether
Mock Suns
be the fore-
boding signs
of great
Calamities.

appear.

appearing of *Mock Suns* any great *Slaughters* or *Revolutions* chance to happen, this cannot seem strange, if we consider the Temper of Men, who are never content with their own condition, but are always reaching after that which is another's. Besides, why should *Mock Suns* portend such events any more than many other natural *Phænomena*? And is it not merely accidental, that they appear this time rather than another? What an unaccountable *Pride* and *Vanity* is it in Man, to imagin himself to be of that value and consideration, that for his sake *Prodigies* must be formed in *Heaven*, that *Comets* must appear when ever the humour takes him to wage *War*; and that *Suns* must be multiplied, when the great *Men* of the *Earth* are at variance together, or some other *Emblems* must be

represented in the *Air*, when ever they are *Sick*, or drawing near to their last end! Pray let us never have so high an opinion and conceit of our selves, as to imagine that all these *appearances* are formed in the *Heavens* on purpose to warn us of future events. But let us rather consider that all these are *natural effects*, which cannot but be formed and appear when ever their causes do concur and meet together. That their appearing but very seldom, cannot in the least conduce to their efficacy, or to render them more considerable: For their Rarity or Infrequency doth no more prove them to be *Prodigies*, than it is an argument that a *Lion* is a miracle in Nature, because we very seldom see any, or for that they are not so common as other *Beasts* that are frequent amongst us.

The Seventh Part

OF THE

H I S T O R Y

O F

N A T U R E

O F

P L A N T S.

CHAP. I.

Of the Parts of Plants.

I.
Why every
Plant hath
a Root.

EVERY Plant hath a *Root*, neither is there any supposed to want this necessary part, except only the *Indian Plant* called *Malabathrum*, whose *Leaves* grow spreading upon the *Water* as if they had not any *Root* at all.

The necessity of this part is obvious from the nature of *Plants*, to the conservation whereof it is absolutely necessary, that some part of it cleave and stick fast in the *Earth*. For a *Plant* with its *Root*, as with a *band* or *claw* lays hold on the *Earth*, and by its spreading *Fibres* takes possession of a part of it. To this may be added that *Vegetables* make use of their *Roots* for a *Mouth*, where-with they suck in their *Nourishment* out of the *Earth*. For seeing that the life of *Vegetables* consists in perpetual motion, their inward moisture would be soon consumed, except a new supply were continually conveyed to them from the *Root*. Neither indeed, if the matter be narrowly examined, will the *Indian Leaf* called *Malabathrum*, nor the *Herb* common amongst us, called *Duck-weed* be found altogether without *Roots*, whatsoever An-

tient Writers may have left recorded concerning them: For when we do more narrowly behold these *Plants*, we shall find them to have a small stalk which reaches to the bottom of the place whence they are taken. And therefore when we dissect a *Root*, we find parts in it that are as substantially the same with the little *Root* of the *Seed*, as the *Members* of a *Man* are the same with the *Organs* of a *Birth* in the *Womb*. So that the *Root* of a *Plant* seems to be nothing else but a spreading of the *Stalk* or *Stem* into several little *Branches* and *Capillaments*. Neither doth it contradict what we have here asserted, that *Mistletoe* or *Dodder* of *Thyme*, and others of the same nature, have no *Roots* that stick in the ground; for tho' they have none, yet the *Plants* on which they grow, and to which they are fastened, have theirs fixed in the *Earth*.

Hence it was that *DEMOCRITUS* was of opinion, that straight *Trees* were shorter lived than crooked ones, forasmuch as their *Roots* were weaker, and for that the straightness of their *Pas-sages* or *Vessels* were not so proper to retain their *Aliment*. Tho' we find the contrary in the *Palm*, *Fir* and *Cypress Trees*, which tho' they be very straight, yet are long lasting, and that because of their thick and long *Roots* by which they suck in their *Aliment*.

II.
Why
straight
timber'd
Trees are
not so last-
ing as o-
ggers.

The

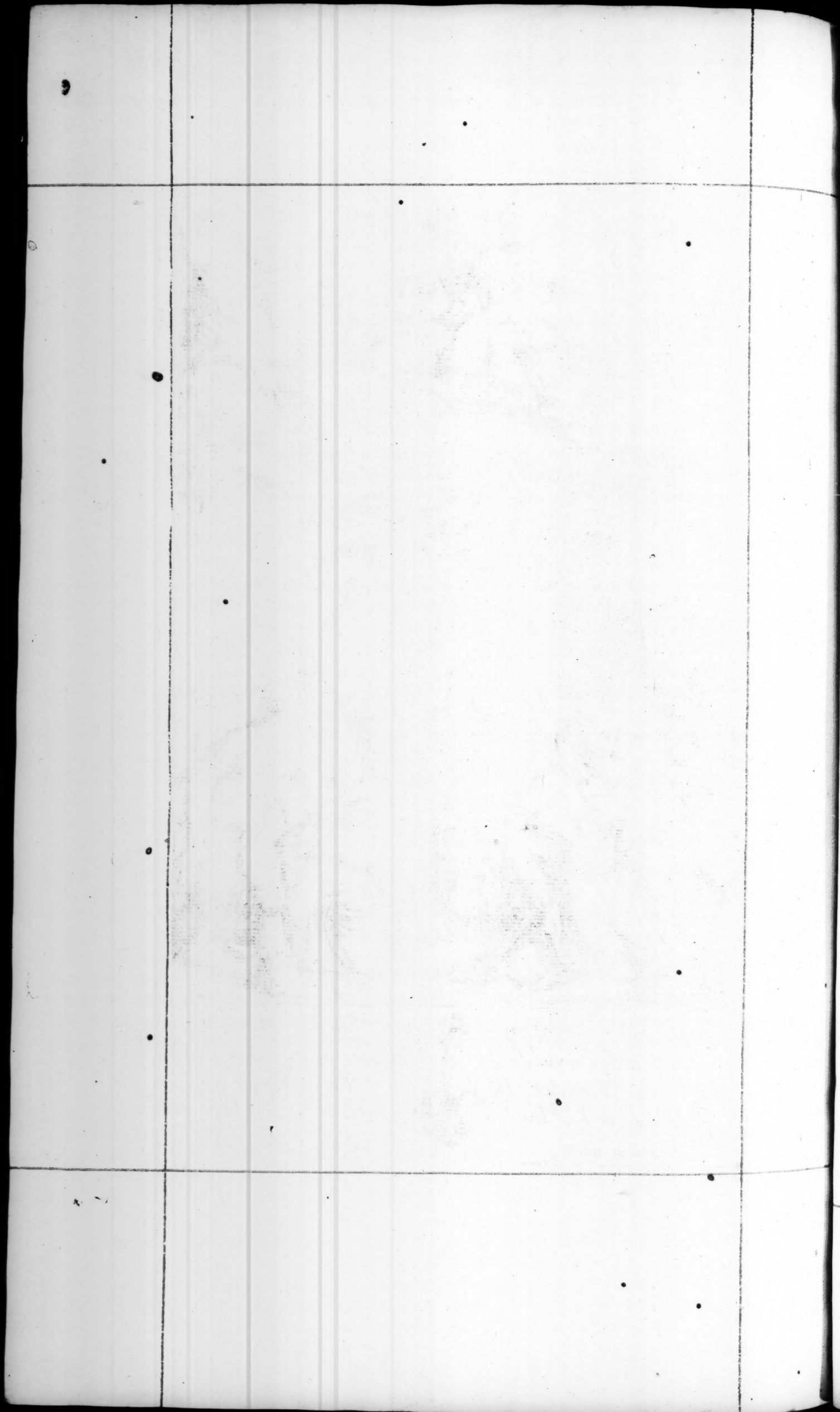


To George London of their Majesties Royall
 Garden in S.^t James-Parke Gent. Deputy Superintendant
 and Master Gardiner of their Majesties
 Gardens and Plantations in England.



This Plate is humbly

Dedicated by Richard Blome



III.
Why the
Roots of
some Plants
are round,
others long
and slender.

The *Roots* of some *Plants* grow more thin and slender, as they enter deeper into the ground, and end in a *Cone* or slender *Point*, as the *Roots* of *Trees*. But the *Roots* of other *Vegetables* swell into a round *Root*, as *Turneps*, *Tulips*, *Onions*, &c.

The Reason why the *Roots* of *Trees*, and most other *Vegetables* are slender towards the ends, is because the *Juice* passing through them, is carried upwards, and abides longer in the upper part of the *Plants*; for tho' the heat, by the virtue whereof *Nutrition* is performed, doth extend it self into all parts, and be carried upwards and downwards, yet it is certain, that it is always more strongly conveyed to the upper parts, than towards the lower; and therefore seeing that the upper part of *Trees* doth receive more nourishment, and is longer nourished, it is no wonder if be also bigger and larger, and that the *Roots* end in a point. But the *Roots* of *Turneps*, &c. are Round, because their nourishment is received into the first joint of them, which consisting of several entangled parts, and being endued with narrow pores, the nourishment cannot freely pass or be strained through them, and therefore it is necessary that the said matter be diffused sideways, and that the *Fibres* which are big and swell'd with juice, spread and enlarge themselves.

IV.
The Compression of the Earth makes the Roots to grow the faster.

If an *Herb* be cut up by the *Roots*, and put again into the *Earth*, and the same be strongly beaten down, and this about the beginning of *Winter*, the *Roots* will be found extremely encreased the following *Summer*.

The Reason is, because moisture having by this means been hindred from entering into the inward parts of the *Plant*, doth the longer continue in the *Root*, and dilate the same. And therefore it is common with *Gardeners* after they have sowed *Onions* and *Turneps*, to press down the loose *Earth* round about them with *Rowlers* or the like.

Some *Plants* have hollow *Stalks*, as all sorts of *Reeds*, and the *Straw* of *Corn*, but with joints.

V.
Why the Stalks of some Herbs are hollow.

The Reason is, because the *Fibres* which serve to convey the nourishment, are not derived from the *Pith* of the *Plant*, but from the sides of the budding *Knot*; which because they withdraw from the middle, and observe a certain distance, do leave a certain space there, and produce a Cavity. Hence it is that in *Onions* the *Pipe* is larger about the midst, because the ends of the *Fibres* spread further from one another, and affect a spherical Figure. For the several Coats of *Onions* are like so many *Leaves*, which being broader about the midst, are roll'd together like the surface of a *Cylinder*.

VI.
Why the Bodies of Trees are round.

Almost all the *Bodies* or *Trunks* of *Trees* have the same Figure, viz. a round one, tho' they differ in length, and other manifold varieties.

The Reason of the roundness of the *Trunks* of *Trees*, is the same with that of the Roundness of the drops of *Liquid Bodies*. For as the *Celestial Globuli*, by their equal pressing of the parts of water towards their Center, do make them spherical; so the same *Globuli*, by dashing against the outside of *Trees*, drive the same to a Roundness. And tho' *Plants* be much inferior in softness to *Water*, and therefore cannot be so readily figured by the surrounding subtil matter; yet this doth not hinder but that the same which is done, as it were in a moment, in the parts of *Liquid Bodies*,

may be done in a larger time, and with often reiterated attempts in harder *Bodies*. So we see that *Iron Work* which was rough before, becomes smooth'd and polish'd by frequent handling, or even rubbing against ones Cloaths.

The outward part of the *Tree*, and which covers it like a *Shift*, is wont to be harder than its inward Substance. Hence it is that most *Trees* shed their *Bark* in the *Spring*.

The hardness of the outside of *Trees* proceeds from other *Bodies* that dash against it. For there are innumerable little *Bodies*, not only of the 1st and 2^d Element, but also particles of the 3^d Element, which continually push and dash against the surface thereof, and drive all the parts towards the midst. Thus our *Hands* and *Feet* by the impulse of other *Bodies*, do contract a brawny hardness; likewise so the *Crust* of *Bread*, and the surface of *Roastmeat*, grows hard by the heat of the *Fire* acting upon it, and much compacter than the inward substance. The reason why *Trees* in the *Spring* do lose their *Barks*, is, because the copious affluence of the alimental moisture, being at that time in greater abundance betwixt the *Trunk* and the *Bark*, doth loosen the *Glew* wherewith they were fastned together.

But for all this, we are not to suppose with some, that all the nourishment of *Trees* is conveyed betwixt the *Bark* and the *Wood*; or, which is the opinion of others, through the *Pith* only, but rather both ways; tho' indeed nothing hinders but there may be a mutual communication or irroration of both these ways with each other. Forasmuch as we see there are some *Trees* which live and grow, when their *Pith* is quite consumed, as *Walnut*, *Willow*, &c. as on the other hand there be *Trees* which grow after that their *Barks* are taken from them.

Almost all the *Leaves* of *Plants* differ, and are of different Figures. For some are large and broad, as those of a *Gourd*; others small and slender like *Hair*, as the *Pine Tree*; and some thick and fleshy, as in *Purflain*, &c.

The conformation of the *Leaves* is caused by the different texture of the *Fibres*, which as they do diversly meet together, and become entangled, or else separate from one another, so they form *Leaves* of different shape and figure. For tho' the *Leaves* of all *Plants* consist of the same parts as their *Branches* and *Trunk* doth (because the thin *Skin* of the *Leaf* is nothing else but the enlargement of the thin *Skin* of the *Branch*, which partly by the occasion of new parts, and partly by the extension of its former parts becomes spread into that breadth) yet do they receive their figure from the various disposition of the *Fibres*. Hence it is that some *Leaves* are long because their *Fibres* lie only stretched out in length, others round, when the *Fibres* display themselves more winding and turning, and so for the rest. For seeing that most of them derive their original not from the *Bark* alone, but from the inward substance, so it is that *Alimentary Juice* is differently suck'd and strain'd, according to the disposition of the *Navel Knot* of the *Tree*, whence the diversity of the *Fibres*, and of the figure of the *Leaves* doth arise.

Hence it is that some *Plants* have long and slender *Leaves*, as the *Willow*; others bent and crooked, like *Orris*; others round and hollow, like *Navel*.

VII.
What is the reason of the hardness of the Barks of Trees.

VIII.
The Aliment of Trees is not only transmitted through the Pith, nor only betwixt the Bark and the Wood.

IX.
What is the cause of the great variety of the Leaves of Plants.

X.
Of the different Leaves of Plants.

CHAP. II.

Of the Virtues and Efficacy of Plants.

SOME Vegetables have a Warming Virtue, and a power to dilate Bodies, as Coleworts or Cabbage, Capers, Cinamon, Radish, Onions, Rocket, &c. others have a power of Cooling Bodies, and drawing them together, as Barly, Cow-cumber, Purslan, &c.

The warming virtue that is in Plants consists in this, that their thinnest particles surrounded with the subtil matter, do enter the Pores of the Bodies, and do so penetrate them, and agitate their parts, as to dissolve their texture, and interrupt their continuity. And therefore from this hindered course of the subtil matter, a kind of contest or variance ariseth, and consequently a greater heat, and agitation of the Parts. As may be seen in the mixture of Spirit of Vitriol and Oil of Tartar, which produceth an Ebullition or effervescence, because the accustomed motions of them both are disturbed, and one of them exerts its force upon the other. Again there are other Vegetables which produce Cold, whose insensible particles are of such a make, that they are able to hinder, or lessen the agitation of the parts of our Body. Thus Purslan and Barley are said to be Cold, because their particles are not easily dissolved by the subtil matter, and because they either altogether stop, or allay the motion of the Vital Spirits. And consequently we may conclude, that the greater particles of the subtil matter are predominant in warm Bodies, but the lesser and weaker in cold ones, because these are less agitated, and more easily reduced to Rest.

Amongst Vegetables, some are cold in the 1st, others in the 2^d, others in the 3^d, and others again in the 4th Degree. Coldness in the 1st belongs to Roses, Violets, Mallows, Barley, Prunes, &c. In the 2^d to Sorrel, Lettice, Plantain, Gourds, Oranges, &c. In the 3^d to Opium, Poppy, Purslan, &c. In the 4th to Meconium or the juice of the Heads of Poppy and Hemlock, which latter by its extrem coldness extinguisheth Life, by stopping the circulation of the Blood.

Beans, Asparagus, the Roots Satyrion, Parsnips, Rice and such like, do provoke Lust, and encrease Seed.

For Seed consists of Blood that hath been very well concocted and strained, and the fore-mentioned Vegetables have the power of agitating, loosening, and so disposing the Organs appointed for the generation thereof; that as soon as the Blood comes to those parts, it is readily strained through them, and by this means the quantity of Seed is encreased. Amongst these Earth-nuts or Pig-nuts may also be reckoned, as producing the same effect. But on the contrary, Lettice, Anise, Hemlock, Purslan and the Seed of Rue diminish Seed, because they, with their particles do obstruct the Pores of those wonderful Strainers; and besides, by thickning the Blood, make it less fit to be strained.

Purslan cures the Teeth when set on Edge, and restores the Gums to their natural disposition, when by the eating of any four or harsh things, they are drawn together.

pelwort; some like a Sithe, as Moonwort. So likewise the surface of some Leaves is smooth and shining, as those of the Ivy; others hairy or downy, as the Malabathrum; some curled, as in some sorts of Cabbage; in some rough, as those of the Fig Tree; in some stinging and prickly, as the Nettle and Thistle; and in some the Leaf is nothing else but prickly, as the Juniper Tree.

XI. Neither do the Leaves only of different Trees vary from each other, but even those of the same Tree; so as it will be hard to find two Leaves on the same Tree that are exactly alike. Who would not think that the Leaves of Olive Trees, above all others, were most exactly like one another? And yet you'll find that all of them differ. And the reason is plain, for tho' the Principles whereof they are formed do perfectly agree together, yet for all this similitude there may be a very great difference between them in relation to the magnitude, number or figure of their parts, and in many other Circumstances.

XII. So likewise it proceeds from the same cause, that some Trees shed their Leaves in Winter, because when the Pores of the Bark are drawn together by cold, the Alimentary Juice can no longer pass through them. But in those Trees whose Leaves proceed from the Inner Bark or Rind, they are not so apt to fall off, by reason of Cold, but only by the encrease of the Shoot that proceeds from the Bud or Knob, which takes possession of the Leaves place, and so causeth it to drop off. Hence it is that in Brasile and Egypt, the Trees are ever Green, nor ever lose their Leaves.

XIII. There is a certain Liquor or clear Juice, which in the Spring doth in so great abundance mount upwards into the Trees, that it is tapt in great quantity from them, without any prejudice to the Trees, as the Birch.

The cause why this Liquor, at the beginning of the Spring, mounts up through those wooden Pipes, called Spiral, is because the Lymphaducts or Vessels of the Bark, through which it is conveyed all the Summer, begin but then first to be formed: Wherefore seeing it finds no passage this way, it takes its course through the Aery Vessels. But as soon as the foresaid Lymphaducts have attained their due consistence and extension, then the Juice returns out of this by-way into the great road, and quitting the Air or Wind-pipes, betakes it self to these as its proper Receptacle.

XIV. Leaves and Fruits, when they are come to their full maturity, are of a Yellow Colour.

The Reason is, because that after the Juice hath been well strained and concocted in them, their particles become like to those that compose Gold, which are so rough, that they produce such a Reverberation of the Light, wherein the Globuli are less whirld round, than they are when they exhibit the appearance of a Red Colour, and more altered than those that represent a White Colour; which is the reason why their superficies is Yellow. This may be further confirmed by looking upon them through a Microscope, for then their surface appears distinguisht with many rising little Pellets or round Bodies, which leaving great Intervals betwixt them, do cause a great variety in the Reflection of the Light.

I. Some Vegetables are endued with a warming, and others with a cooling virtue.

II. The difference or several degrees of coldness in Plants.

III. Why some Vegetables provoke Lust.

IV. How Purslan restores our Teeth when set on Edge.

The

The Reason is, because this Numbness of the Teeth proceeds from the particles of four Bodies, which penetrating through the Gums, draw together the Jaw-bone, and consequently the Teeth themselves. And forasmuch as Purslane aboundeth with Clammy Juice, which as soon as it comes into the pores of the Gums, the foresaid four and sharp particles stick to them, and are carried off by the Spittle. Salt is also said to produce the same effect; for when we rub our Teeth with it, it opens the pores of the Gums, whence the Spittle flowing in great abundance, carries those sharp Bodies along with it. Thus the Root of Pellitory of Spain, is often with good success held in the Mouth by those who are troubled with the Tooth-ach, because it draws the humours powerfully into the Mouth together with our Spittle. For it causeth a kind of Salivation, being held in the Mouth only, which may it be it would do both for a longer time, and more copiously, in case it were taken inwardly in a small, but often repeated Dose.

Some Vegetables make Bodies hard and solid; whereas others make them soft and flexible.

Bodies grow hard by the mixture of some Herbs, when the particles whereof they consist, having before been agitated by heat, and separated from one another, are seized by the Juice of these Vegetables; which entering their Pores, and putting a stop to their Agitation, makes them to come nearer to one another; for by the operating of their thinner particles, the remaining become so much the closer united together. And on the other hand hard Bodies become flexible, when their particles being separated by heat, a foreign moisture getting between them, keeps them at a distance, and by its interposition makes them flexible. For the softness or pliability of any Body consists in this, that its parts are divided from one another, and have something running between them. Amongst those Vegetables that are endued with a consolidating virtue Thorough Wax is one.

Some Herbs are endued with a Diuretick Virtue, as the Roots of Fennel, Saxifrage, Smallage, Juniper Berries, Nettles, Bitter Almonds, and the like, which provoke Urin.

This faculty in these Plants proceeds chiefly from their heat, because their particles are easily agitated by the subtil matter. For seeing that obstructions are the cause of the retention of Urin, these are endued with a penetrative power, and consequently are proper to remove those obstructions which stop the free course of Urin. For entering into the pores, they attenuate and cut the tough Flegm, and dissipate the grains of Gravel, which before, by means of some slimy moisture stuck together, and carry them off. So that the pores of the Kidneys being loosed by this commotion, the matter contained in them becomes dissolved, and easily passeth through them in order to its evacuation by urinary passages. And the case is much the same with those Herbs that move Womens Courses, by thinning and diluting their stagnating Blood, such as Saffron, Penny Royal and Sage, because by their heat they open the obstructions of those vessels by which the Blood is conveyed to the Womb. And accordingly we find by experience, that almost all Diuretick Plants are hot, as Rhadish, Rocket, Cinamon, &c.

Dandelion is reckon'd amongst Diuretick Plants, which by opening of the obstructions of the Meseraick Veins, conveys a greater quantity of Urin into the Bladder, than little Children are able to contain, and so makes them let go their Urin when they are asleep in their Beds: And therefore the name of Pissabed is also given to this Herb. So likewise the Decoction, Juice and distilled water of Seseli or Hart-wort, or the Seed of it in Powder is very efficacious for the moving of Urin, breaking of the Stone and expelling it; and is to that purpose exhibited to Infants as well as grown Persons.

Some Vegetables have an Anodyne Virtue, that is, such as mitigates the pains of the Flesh, and heals Wounds.

All Adstringent Plants are endued with this virtue, and which consist of Particles like to those of Aloë; which entangling together, and penetrating the inward parts, do suck and draw out the hurtful and superfluous moisture from them; by which means the part is disposed to admit and receive its due and proper Aliment, so that the Wound by degrees is filled with new Flesh, and so brought to a Scarr.

Amongst Vulnerary Herbs are accounted Advers Tongue, which is an excellent Wound-herb, whether inwardly taken, or outwardly applied. The Green Leaves of it do conglutinate Wounds and cure those that are troubled with Ruptures: It is exhibited in the distilled water of Horsetail for the healing of inward Wounds: And some Physicians assure us, that the Powder exhibited for many days together cures all manner of Ruptures. The Herb called Ladies Mantle, is also an excellent Traumatick or Wound-herb, it heals, dries, adstringeth, stops bleeding, and stops the Whites and Courses of Women. The Leaves, Top and Root of this Herb is often added to vulnerary Potions, Plasters and Ointments.

Thus Marsh mallows, Wheat, the Root of White Lillies and Camomile do allwage pain; and St. Johns Wort, Mastick, Barley-flower and Birtswert do restore the Flesh in a Wound or Ulcer. Thus Plantain, Pomgranate-shells, &c. have a Glutinating Virtue, because they are Styptick or Adstringent, and consist of such particles which entangle one another, and pressing upon the part that lies under them, do as it were squeeze the superfluous moisture of it.

Poppies, Quinces, the Juice of Pomegranates, and other such like, stop fluxes of blood.

The Reason is, because the particles of these Bodies insinuating themselves into the Pores, do divide the agitated particles of the blood, and by interposing themselves, make a separation between them: So as by this means they are no longer so much agitated as they were, and by this means come closer together. Or else the cause of this effect may be, because the Juice of Pomegranates, for instance, lying upon the mouths of the Veins and Arteries, obstructs their narrow passages, and doth not suffer the Blood to come forth. For we find by experience, that the efflux of blood is stoppt by cold; as when in the bleeding of the Nose we apply cold water to our Temples or Nostrils, or a plate of Iron or a Key to the Nape of our Necks.

VII.
Dandelion
and Seseli-
um provoke
Ur n

VIII.
Why some
Herbs cure
Griefs and
Wounds.

IX.
Of Vulnera-
ry Plants.

X.
Of the use
of Styptick
or Adstring-
ent Herbs.

XI.
Poppies and
Quinces are
endued
with a vir-
tue to stop
fluxes of
Blood.

Horse-

V.
How some
Vegetables
make Bo-
dies hard,
and others
make them
soft and
flexible.

VI.
Wherein
the Diure-
tick Virtue
of Vegeta-
bles doth
consist.

XII.
Of Styptick
or Adstringent
Plants

Horsetail is a powerful *Adstringent*, and is accordingly used with great success in *spitting* or *vomiting* of Blood, stops excessive *blood-fluxes*, and all other *fluxes* of the *Belly*: For which purpose either the *Herb* it self may be taken in *powder* to the weight of one *Dram*, or of the decoction of it in *Wine* four Ounces, Morning and Evening, or if three Spoonfuls of the *distilled water* be drunk for two or three days together. Much the same virtue is also found to be in the *Herb* call'd *Great-water-dock*, all the parts whereof, *Stalks*, *Leaves*, *Flowers*, *Seeds*, but more especially the *Roots*, do very powerfully *adstringe*, *harden* and *conglutinate*. And therefore this *Herb* successfully puts a stop to, and *heals* all putrefying spreading *Sores*, as the *Rose*, whether whole or ulcerated, *Ringworms*, *Fretting*, *Exvils*, *Gangrenes*, &c. And stops all manner of *Fluxes* of Blood whether of *Emrods*, or of *Womens Courses*.

XIII.
Why some
Herbs en-
crease Milk.

Some *Herbs* conduce much to the encrease of *Milk*, as *Fennel*, *Poly-mountain*, *Milkwort*, &c. Others encrease *Seed*, as *Sparagus*, *Pine-nuts*, *Rice*, &c.

The former of these help to encrease *Milk*, because they nourish much; and therefore being mingled with the *Alimental Juice*, they open the *pores*, and remove the obstructions of those *passages* through which the *Chyle* is conveyed to the *Breasts*. For it is certain, that by a slight straining only, the *Chyle* becomes changed into *Milk*. And the Reason is much the same as to those *Herbs* which promote the *generation* of *Seed*; save only in this one thing wherein they differ from the former, *viz.* that they abound with more *Salt*, and diffuse a greater *heat* through the *Body*. By which means the *Organs* appointed by nature for the *generation* of *Seed*, are more opened, and consequently give a more free passage to the *matter*.

XIV.
Why
Worm-
wood, Bit-
ter Al-
monds, &c.
destroy
Worms.

Wormwood, *Bitter Almonds*, *Hartshorn Philosophically* calcin'd, &c. kill *Worms* and expel them out of the *Body* of *Men*.

The Reason is, because these *Simple*s are *bitter*: For *Worms* delight only in things that are of a *sweet taste*, and with which they are nourished, as well as they were generated at first from them. For *bitter things* consist of rough *particles*, and which on all sides are surrounded with *prickles*, and consequently entering into the soft and spongy *Bodies* of *Worms*, they rend and tear their *inwards*. And by this means the *Worms* are killed, or avoiding the said *bitter things*, are expell'd by *Stool*, or sometimes tending upwards, are voided at the *Mouth* or *Nostrils*. *Corallina* or the *Sea-moss* that grows upon *Coral* is very famous for its efficacy in destroying *Worms* and expelling them, being given in *Powder* mixt with *Wine*, *Milk*, or the extract of *Cassia*, to the quantity of half a dram to *Children* under 14 years of age, and to those who are elder to the quantity of a whole dram.

XV.
How the
qualities of
the Herbs
that Ani-
mals feed
upon, come
to be com-
municated
to their
Milk.

Nurses Milk oft partakes of the *Odor* and *Taste* of the *Herbs* they have eaten: And it is notorious that *Cows* according to the difference of the *Herbs* they feed upon, do give a different *Smell*, *Taste* and *Colour* to the *Butter* that is made of their *Milk*.

The Reason is, because the *Milk* is made immediately of the *Chyle*, and not out of the *Blood*, which hath been formerly the common opinion. For the *Chyle* is carried from the *Stomach* to the

Breasts, and by some particular passages is carried from the *Guts* to the *Receptacles* of *Milk*. This is confirmed by the daily practice of *Physicians*, who give *Purges* to *Nurses*, when their *Nurslings* stand in need of being *purged*, because the purging quality of the *Medicin* is communicated from the *Chyle* to the *Milk*; but not to the *Blood*, which takes a much longer circuit through the *windings* of the *Heart* and *Arteries*, and undergoing several changes, cannot possibly retain the *Cathartick Virtue* of the *Medicines*. For how can it be that, when a *Nurse* drinks *Milk* ting'd with *Saffron*, within half an hour after the *Milk* in her *Breasts* should be of the same *colour*, *smell*, and *Taste*, if *Milk* were made of the *Blood*, and not of the *Chyle*, which by some secret and short passages, is conveyed to the *Breasts*? All which is further confirm'd by that *Leaf* of *Succory* which a *Surgeon* took out of the *Breast* of a *Roman Matron*, and which she had eaten the night before.

CHAP. III.

Of the obvious, or known Qualities of Plants.

GREEN is the common colour belonging to *Plants*, not only to them that are yet young and flourishing, but also to some when they are old and withered.

It is evident from what hath been said before, that the nature of *Colours* depends on the various *Reflexion* of *Light*, and the various disposition of the *surfaces* of those *visible Bodies* upon which it falls. So that those *Bodies* are of different *Colours*, whose outward *particles* are variously posited, and reflect the *Beams* of *Light* to the *Eye*. Thus the *Green Colour* we find in growing *Plants*, proceeds from the copious *moisture* wherewith they abound, the *particles* whereof are so mixed with other foreign *particles*, that they reflect and refract the *Light* in the same manner as those *Bodies* do, which in *Rivers* or standing *waters* are turned into *Moss*. And thus according to the various mixture of this moisture with the *External matter*, a different degree of *Greeness* is observed in *Vegetables*. For some of them are of a most deep *Green*, and such as these abound most with *moisture*, but their *juice* is not so exactly percolated as that of some others. Others are of a more pale *Green*, that is, such whose *Leaves* are of longer standing, or whose *Fruits* are come to their full maturity. Because in process of time a great part of the *moisture* flies away, and the crude or raw *Juice* being digested by *heat*, arrives at perfect *Ripeness* and *Concoction*. Hence it is that the *Leaves* of *Plants* sometimes put on other *colours*, and become *Yellow* or *Red*.

And whereas *Fruits* do very much differ in their *colours*, *Pears* and *Apples* being whitish, *Plums* yellow, *Blue* or *Purple*, *Cherries* *Red* or *Black*; this proceeds only from the various percolation of their *Juices*, and the different texture of their parts. For it is apparent that the *Juice* in an *Apple* or *Pear* is first coagulated into *Froth*, which afterwards becomes a hard *Flesh*; whereas in *Apricocks*, *Figs*, *Cherries* and *Grapes*, the same *Juice* is turned into a much softer substance. And therefore no wonder

I.
Why Vegetables are commonly Green.

II.
Why the Fruits of Plants are of various colours.

wonder if from this different disposition of their particles, such different colours are produced in them.

The Root which lies hid in the ground, is commonly more tender than the other parts of the Plant, and for the most part of a white colour.

The Reason is, because the particles of the Juice, which by heat are agitated within the pores of the Roots, endeavour to get out, and accordingly in effect many of them do break their Prison and fly away. But being hindred by the Earth, that lies about them, from going further, they return to the Root again, where undergoing a 2d Concoction, they make the Root the more tender. And forasmuch as that moisture which imparts a Greenness to the Leaves, is by the warmth of the Earth changed into froth, this makes the Root to look white, because according to the multiplicity of its surfaces, it reflects various parts of Light. Hence it is common with Gardners to cover some Plants with Mould or Sand, as Succory Endive, Cabbage, Leeks, &c. to make them tender, and to give them a white colour.

Some Vegetables are much more odorous than others: For such as grow in Arabia, and other hot Climates, are of a stronger fragraney than others; as appears in Cinnamon, which keeps its odour for many years.

The Reason is, because the odoriferous Steams that proceed from Bodies, do consist of sulphurous or fat matter, which being attenuated by Heat, and reaching the mamillary processes of the Nostrils, doth affect them either softly and pleasantly, or harshly. And forasmuch as those Vegetables which grow in hotter Countries, are more exposed to the Rays of the Sun, which exhale the watry humours, the fat and sulphurous humour only remains, which furnisheth the matter of all Odours, and is the more readily conveyed to our Nostrils, as being disentangled from the encumbrances of the watry particles. Now that this fat and sulphurous matter, is that wherein the Odours of Bodies doth consist is evident from hence, because when this sulphurous matter is taken away by distillation, the odour or fragraney that is in that Body is taken away together with it, as appears in the Caput Mortuum, or remaining Dregs that are left in the Alembick after distillation which hath no scent at all. And therefore it is no wonder, that those Plants are of a stronger scent, whose fat and oleous particles are resolved by heat; and that those are of a weaker scent, and do less affect our Organs, which grow in moist and wet places. Because their Juice is not thoroughly digested for want of heat, and the abundance of moisture hinders the due concoction of the sulphurous matter, and keeps it from being dilated and rarefied. Hence it is that such Plants as these do smell more strongly when they are dry, than when moist and green, because then the odorous particles breath forth more freely, as being no longer drowned or entangled in moisture.

Fruits have not always the same smell, but change the same according to their several stations: For such as are near their perfect Ripeness, do smell more sweetly than those that are green and unripe.

The Reason is, because since odour consists in the dry and thin parts of Bodies, the same is made

the more pleasant, and doth more softly affect the Organ of smelling, by how much the matter of the said odorous Steams is more thin and better digested: Which certainly is then, when Fruits are arrived to the pitch of perfect maturity, and ready to be gathered. For then by reason of a long decoction the Juice is more purified, the parts digested, and their perfect percolation advanced. And when this happens, no wonder if copious steams proceed from Fruit at this time, and more pleasant smells than when they are only in their first tendency to maturity.

Almost all Fruits are distinguish'd by their Taste, as affecting the Tongue and Palat after a peculiar manner. Some are of a harsh taste, as Sloes; other of a smart or sharp taste, as Onions, Mustard, &c. some sweet, as Wheat; some sower, as Sorrel; some bitter, as Wormwood, Aloes, &c.

This difference of Taste in Vegetables, proceeds from the different texture of their particles whereof the Fruit consists, and which entering the Organ of the Taste, do affect the same. For these little Bodies, when they are mixed with the Spittle, have the power of moving the Tongue, and impressing several affections upon it. Wherefore the particles of such Bodies which draw the Tongue together, and make it rough and harsh, are said to be of a harsh or sower and adstringent taste as unripe Fruit. And such whose particles prick the Tongue, and divide it with the sense of a kind of dilating heat, are said to be of a sharp, smart and biting taste, as Pepper, Mustard, Arsmart, &c. Those which smooth the Tongue, and pleasantly affect, are called sweet, as Licorish, &c. Those which prick the Tongue, and affect it with a constringent sensation of cold, are called sharp and styptick, as Cypress Nuts, the Rind of Pomegranates. Such as impress a kind of dryness upon the Tongue, are called bitter, as Aloes, Coloquintida, the Lesser Centaury, Wormwood, &c. So that the whole difference of these Bodies consists only in this, that their particles are of a different magnitude, and vary also in their Figure, Motion, Hardness, Lightness and several other ways.

Thus we find by daily Experience, that when a Man hath tasted Vitriol before his taking a Pipe of Tobacco, the smook will seem as sweet to him as Honey, and with a pleasant tickling will affect his Organ of Taste; because the styptick or adstringent saline particles that are in the Vitriol, being impregnated with the sulphureous particles evaporated from the Tobacco, do produce a sweet Taste.

Some Fruits do change their Tastes, so as that those which before were biting and bitter, become sweet and grateful; thus Garlick and Onions, being boiled in water, lose their Acrimony.

The Reason is, because the Taste of Fruits consists in their stiff and pricking saline particles. And therefore Garlick and Onions become sweet and pleasant when they are boil'd, because the fire opening their pores, makes way for the saline particles to exhale. Hence it is also, that all Fruits, as they ripen, grow sweeter; forasmuch as upon the evaporating of their moisture, their salt Armonack and other volatil saline particles fly away, leaving these only behind them that procure a sweet Taste to the Fruits. And it is for the same

III.
Why the
Roots of
most Plants
are white.

IV.
Whence the
Odours of
Herbs do
proceed.

V.
Why Fruits
in their
progress to
maturity
change
their smell.

VI.
The cause
of the dif-
ferent Taste
that is in
Fruits.

VII.
Why the
smook of
Tobacco
seems sweet
after the
tasting of
Vitriol.

VIII.
Why Gar-
lick and
Onions lose
their bit-
terness by
boiling.

reason that *Garlick* and *Onions*, being soaked in boiling water, acquire a milder Taste, viz. because the particles of Salt that were in them are dissolved by the water, and being intangled with it, do evaporate into the Air. Thus the Root of *Arum*, when new took up out of the Ground, is of an extream smart, biting and pungent Taste, but being dried, and especially being long kept so, becomes insipid, and consequently inefficacious and of little or no virtue.

CHAP. IV.

Of the Occult Qualities of Plants.

I.
Wherein
the Purga-
tive Virtue
of Plants
doth consist.

THE Occult Qualities of Plants, are generally such as belong to Medicin, and are discernible by Reason, rather than by the Senses. Amongst these we will first speak of the Purgative Virtue or Quality wherewith several Plants are endued, and by means whereof they expel excrementitious and corrupt humours out of the Body by siege. Thus *Rhubarb* and *Scammony* purge *Choler*; *Sena*, *Polypody of the Oak*, *Dodder of Thyme*, *Heliebor*, &c. *Black Choler* or *Melancholy*; *Carthamus* or *Wild Saffron*, *Agarick*, *Herb Mercury*, *Spurge*, and the several sorts of it, *Phlegm* and watry Humours; *Fumitory*, *Cassia Fistula*, *Prunes*, *Bugloss*, purge and cleanse the Blood from its dregginess.

The Opinion of the Antient Physicians was, that Medicins that are endued with a purgative virtue, exert the same by a likeness of substance to those Humours they attract and expel out of the Body. And therefore GALEN who made the purging virtue of Simples to consist in attraction, *Simpl. Lib. 3.* asserts a similitude between the substance that purgeth, and that which is purged: So that Purgive Medicins, according to his Opinion, do pick out some particular humour, which they expel out of the Body, viz. some, *Choler*; others, *Phlegm*; some, *Melancholy*; &c. But I cannot be induced to comply with this opinion, seeing that daily experience teacheth that the *Melancholy Humour* which is tough and clammy, is expelled by *Cassia* and *Coloquintida*, which have no affinity at all, or likeness of substance with that Humour. So likewise the watry or ferrous humours of Persons afflicted with the *Dropsie*, are evacuated by *Aloes* and *Rhubarb*, when yet there is no similitude between their substance and that of the Moisture they expel.

II.
There is no
need of this
similitude
between the
Medicins
and Hu-
mours they
evacuate.

But if we examine this point more narrowly, we shall find that contraries are rather cured by contraries. For what Physician doth not know that the deterfivive quality that is in *Wormwood* consists in its sulphurous Spirit; that the Roots of *Plantain* and *Bugloss* do thicken thin *Choler* by the clammy consistence of their Juices; that all the *Scorrels*, *Juice of Limons*, and all *Acids* do thin and cool the Blood, and allay its Fury, not with adust Sulphur, but with their acid and cold Spirits? Besides infinite other Simples, which either by softning or asswaging do purge those Humours with which they have no similitude at all.

III.
Purgative
Plants exert
their

Conclusion we therefore, that Purgive Medicins expel corrupt humours by fermentation in this manner: The Medicament as soon as it is

taken into the Stomach, doth there meet with a sharp humour, which flows from the Heart through the Arteries, whereby, as with an *Aqua-Fortis* it is dissolved: But forasmuch as it is of a different substance from the said Juice, and therefore doth not mingle with it without difficulty, the Juice by means of the Medicin, begins to swell and ferment; as we see that Wine doth, by reason of its Sulphureous Lees, or by the mixture of some Heterogeneous Substance with it. Afterwards this Medicament is carried to the Lacteal Veins, and from thence to the common Receptacle detected by Pecquet, and thence to the Ductus Thoracicus or Breast-passage, and so is conveyed into the left Axillary Vein where it is contounded with the Blood. But because by reason of the Heterogeneousness of its Parts it cannot be united with the Blood, therefore it joins it self with the *Choler*, *Phlegm*, or other Humour lurking in the Blood. And forasmuch as it is carried with the Blood throughout the whole Body, it doth in its passage twitch and prick the parts, whereupon they become contracted, and squeeze out the humours that were lodged in the Vessels belonging to the said parts. Now while all the parts of the Body do thus successively expel these humours, and they find no refuge for themselves in the Veins, they are driven towards the Stomach and Guts, which they irritate to expulsion, and so are evacuated with the common excrements of the Food. Thus according to the difference of the Plants, different Humours are expelled; as *Choler* by *Scammony*, *Phlegm* by *Coloquintida*, *Melancholy* by *Black Heliebor*; *Black Choler*, so called, by *Dodder of Thyme*, *Sweat* by *Sarsaparilla*, &c.

Some Vegetables excite Vomiting, and evacuate Humours by the Mouth; as the middle Bark of *Walnut-trees*, *Coloquintida*, *Broom Leaves*, *Nux-vomica*, &c.

The virtue of these Vegetables is not much unlike that of Purgive Medicaments, save only in this, that their operation is more swift, by exciting a quicker Fermentation. Corrupt Humours therefore are expelled by Vomit, when the Stomach being vellicated or twitched by the particles of the Medicament, becomes so contracted and drawn together, that it can no longer contain the matter that is in it, and consequently drives forth the Humours that oppresses it. And therefore it is dangerous to exhibit Vomiting Medicaments to those who are troubled with the *Ptisis* or Consumption, or that have strait Chests, lest the Stomach should not have room enough to display it self in vomiting, or by a too violent compression of its Fibres should occasion a dangerous Convulsion. This vomitive virtue is found in the Herb *Groundsel*; the Juice whereof being taken in Beer, or the decoction of it in Water with *Currans* or *Hony*, affords a gentle Vomit. So the Water of a certain Thistle called *Silybum*, being drunk causeth vomiting: And the Root of the Herb *Thapsia*, as well as the Juice or Decoction thereof, doth purge upwards and downwards with great violence, and therefore is not safe to be given inwardly.

Some Plants cure the Diseases and Grievs of some parts: Thus *Betony*, *Hyssop*, *Maiden-hair*, &c. are good for the Head; and particularly *Sweet Marjeron* do help the cold affections of the Head.

efficiently by
fermentation.

IV.
What is
the cause of
the Vom-
itive Virtue
of some
Plants.

V.
Of the dif-
ferent vir-
tues that
are in
Plants.

Head and Brain, which way soever it be taken; the Powder of the dried Herb snuff up, provokes Sneezing, evacuates Pilegm and strengthens the Brain; and the same effect is caused by the Juice of the Herb snuff up. Borrage, Angelica, Bugloss and Balm, strengthen the Heart, and remove the Distempers of it: Wormwood, Sage and Aniseed are good for the Stomach. Thus Endive and Succory are appropriated to the Liver, and afford a most excellent Remedy to remove the Heat of the Liver or its obstructions, which way soever it be taken, whether the Leaves of them be eaten raw or boyled, or the Juice, distilled Water or Decoction of them; and therefore greatly commended in Fevers.

The Reason of all these manifold virtues is to be lookt for in the different texture of their parts. For seeing that the disposition of the parts of the Head, Heart, Stomach and Liver is different, they must consequently be cured by different Remedies. Now Bodies, according to their various Figures, produce also various effects. Thus subtil and thin Bodies are aperitive or opening; thick Bodies, incrassate; sharp and biting are absterfve, and cutting or inciding.

There are some, who with the smell of Herbs or Drugs, are purged, much after the same manner as if they had taken a purging Medicament inwardly. Thus I knew an English Gentleman in Flanders, who when ever he passed by an Apothecaries Shop, was moved to go to Stool, as if he had taken a Purge.

The Reason of this was, because the particles flowing from the Purgative Drugs or Medicins, did so agitate the Brain, and consequently the Nerves of this Person, that thereby they put the Humours in the same motion, as might have been expected from a purging Medicin; viz. by the rushing of the Spirits against the Fibres of the Stomach and Guts.

Cats take a very particular pleasure in Catmint, tumble themselves over it, and seem wonderfully pleased with the touching of it.

The Reason is, because Catmint consists of such particles as have a great sympathy and agreement with the Brains of Cats: For seeing that Beasts are not led by Reason or Judgment, but by a meer impulse of Nature, or rather by the disposition or make of their Organs, they cannot but be allured by those objects that present themselves to them; which could not be, except some steams did proceed from them, with the scent whereof they are affected. Wherefore we may conclude that in Catmint there is such a Texture of Fibres, as hath a great agreement and correspondence with that of the Brains of Cats.

A piece of Pompion put into a Pot in which Flesh is boyling, doth make the same more tender than ordinary.

The Reason is, because the Pompion abounds with strong Spirits, and a sourish Juice: Now it is manifest that all sour things are endued with a resolving virtue, which daily experience shews us concerning Vinegar. And PLINY assures the same concerning sharp pointed Docks, viz. that being boyld with Flesh, it makes it more soft and tender; because its sharp and corroding quality doth dissolve the Texture of the Fibres.

The same virtue is by Ectanists attributed to Hippolapathum or Patience, which renders the oldest and toughest Flesh, when boyld with it, tender and fit to be eaten. For this Herb being of a slippery and moist nature, it makes the oldest and toughest Beef, or any other Meat, soft and tender. And for this reason the use of it was very frequent amongst the Antients, because it renders the Meats boyld with it, easie to be concocted, and besides, makes the Body soluble.

Some Plants are endued with a pernicious power of killing Animals. Thus the Herb Napellus, which is a kind of Wolfsbane, doth by its extream heat burn the Body, and scorch and consume the firmer parts of it.

This effect is also to be attributed to the figure and motion of Plants, by means whereof they exert their virtues, and perform those effects we are surpris'd at. For it is most consentaneous to reason, that the parts whereof Poisons consist, are very stiff, penetrating, hard, and armed with Prickles: In the same manner as we find by the Microscope that Nettles are armed with an infinite number of prickles; wherefore such Bodies as these being fermented in the Stomach, and mingled with the various Humours therein contained, doth excite a very violent Ebullition, especially when it is conveyed out of the Vena Cava into the left Ventricle of the Heart, and from thence into the right. For its heat being here encreased, it breaks forth with extream violence, and rushing upon the inward parts, doth with its sharp points and prickles penetrate, corrode and tear their substance.

Again, there are other Plants which are of a contrary virtue, and which kill Animals by their coldness, as Hemlock, which kills People, or makes them go mad or senseless; and Scammony which doth so draw the Wind-pipe together, that it sometimes choakes and kills Men.

The efficacy of these Plants consists in this, that they stop the circulation of the Blood, and suppress the Native Heat; for seeing that the motion of the Blood is smooth and easie, as passing through all the parts of the Body with an even Courle, when ever cold, or slowly moved Bodies do enter into the mass of it, they disturb and confound the motion thereof, and dull or diminish the heat of the Plants: And being through the Veins carried to the Heart, they cool it, and reduce it to a kind of lukewarmness. For whether the agitation of the particles of the Poison, be contrary to the motion of the Blood, or whether the slowness of their motion do destroy its heat, still the same effect will follow, if by their entering into the Heart a change is made, and the Orifices through which the Blood is conveyed thither, be never so little obstructed. For no other reason can be assigned why the eating of Hemlock, makes persons mad or senseless, but because the said Herb taken inwardly, causeth disorderly twitchings or vellications of the Brain, by which means the Spirits are hindered from their natural and due motion through the Fibres of it.

Thus Physicians tell us, that when the Air is corrupted by noxious exhalations, the Plague and other Epidemical Diseases are produced; for the particles of the Pestilential Steam being taken in with the Breath, and insinuating themselves into the Blood, do confound the natural ranging of its

IX.
The same
virtue is
also found
in the Herb
Patience.

X.
Why some
Plants are
of a dele-
rious
quality,
and kill
living Cre-
atures.

XI.
Hemlock
kills by its
great cold-
ness, and
Scammony
choakes
men by
drawing of
the Wind-
pipe toge-
ther.

XII.
How the
Plague is
propagated.

VI.
Why the
Odour of
Herbs some-
times per-
forms the
same effect
which the
substance of
the Herb
taken doth
produce.

VII.
Why Cats
are so much
delighted
with Cat-
mint.

VIII.
Why a
piece of
Pompion
being put
into a Pot
wherein
Flesh is
boyling,
makes the
same ten-
der.

par-

particles : Even as the *Rennet* when mingled with *Milk*, and diffused through the substance thereof, doth so change the ranging of its parts, as to make a fixt *Body* of that which was fluid.

XIII.
The Root of
the Tree
Baxanta is
present Poi-
son.

And probably it is for no other reason, that the *Root* of a certain Tree called *Baxana*, growing in a Kingdom belonging to the *Dominions* of the *Great Mogul*, doth immediately cause death to them that take it, by stirring up a sluggish drowsiness or heaviness over the whole *Body*; but because as soon as it enters into the *Blood*, it doth by its coldness allay the heat of the *Heart*, and by this means diminish the heat that is in the extreme parts of the *Body*, and afterwards by degrees cools the *Blood* that is in the *Veins* and *Arteries*, whereby soon after the *Heart* it self is seized and nummed. But what is most wonderful is that *Historians* tell us, that the *Fruit* of the said Tree is altogether harmless, and is safely eaten by the *Inhabitants*; the reason whereof probably is, because the *Fruit* is better concocted by the heat of the *Sun*, and the cold *Humours* discurr and exhaled.

XIV.
Hemlock is
not hurtful
to all li-
ving Crea-
tures.

Neither is *Hemlock* always hurtful to all living *Creatures*: For *Starlings*, if we may believe *GALLEN*, do commonly feed upon it, and without receiving the least hurt thereby. And some *Anatomists* tell us, that they have found the *Crop* of a *Buffard* full of *Hemlock Seeds*, which had only 4 or 5 grains of *Wheat* mingled amongst them. And the Poet *LUCRETIVS* adds,

Thus with cold Hemlock Goats we fasted see,
Tho' it to Man a present Poison be.

Wherefore it appears that *Hemlock* is not deadly to all *Animals*; seeing that the use of it inwardly is commended by Modern *Physicians* in the *Swelling* and *Inflammation* of the *Spleen*, as the *Juice* of it is an ingredient in *Splenick Plaisters* to soften the hard swellings thereof.

XV.
Whence
Wild Fig-
trees hath
the power
of taming
a mad Bull

A *Mad Bull* is tamed by tying a twig of the *Wild Fig-tree* to his *Neck*; and the same *virtue* is also attributed to the *Herb antheris*.

This may come from the *Steam* proceeding from that *Plant*, which being diffused through the *Wild Bulls Brains*, doth so affect the *Nerves* thereof, as to cast him into a stupidity or numness, whereby he loseth all his strength. The same is related by some concerning the *Lion*, that as soon as he is but toucht with the *Herb Adamantis*, he lies with his *Mouth* open upon his *Back*, as having quite forgot his wonted strength and fierceness.

XVI.
Whence
some Herbs
have a
virtue of
resisting
Poison.

Some *Herbs* are endued with a *virtue* against *Poison*, and therefore are called *Antidotal*, or *Alexipharmical*. Thus *Purslain* cures the biting of *Serpents*; *Endive* that of *Spiders*. *Wine* resists the cold *Poison* of *Hemlock*. And besides these, *Marygolds*, *Carduus Benedictus*, *Angelica*, *Rue*, &c. do powerfully resist *Poisons*, and break the force of them.

The Reason is, because these *Plants* consist of such parts as have a great affinity with the particles of those *poisons* which they overcome, and therefore easily join with them; and by this means do by their interposition break the force of them, and change the ranging and figures of those *Bodies*, which without their conjunction, do fix and

coagulate the *Blood*. For hot things do easily discurr and overcome the violence and malignity of cold *Poisons*; and therefore the *Publick Executioner* adviseth *Crito*, that he should not suffer *Socrates* to dispute too earnestly, lest his *Body* should be too much heated, *SCALIGER* Exercit. 52. Moreover cold *Plants* also are found to be of use for the curing of cold *Poisons*, by drawing them out of the *Body*; because when the *Blood* is coagulated by cold, it is dissolved again by the supervening liquor, and its nimblest particles are put into motion again; and both of them being thus confounded together, are variously agitated, and at last thrust together out of the *Body*.

CHAP. V.

Of the Sympathy and Antipathy of Plants.

THE *Female Palm tree* seems to delight in the nearness of the *Male Palm*, and becomes more fruitful by standing in its Neighbourhood; and therefore inclines her *Top* and *Branches* that way; and being removed farther from the *Male Palm*, languisheth, and sometimes withers and dies.

I.
Why the
Female
Palm-tree
delights in
the Neigh-
bourhood of
the Male
Palm

The Reason of this sympathy between both these sorts of *Palm trees*, is a certain steam which proceeds from the *Male Palm* to the *Female*, which abounds with a *seminal* and *fecundating virtue*, and insinuating it self into the *Female Plant*, makes her more flourishing and fruitful. For it seems that in this case it happens with the *Palm-tree*, as with *Hens*, which lay *Eggs* indeed without the *Cocks Treading*, but yet the said *Eggs* cannot be animated or become prolifick, tho' the *Hen* sit never so long Brooding upon them. So *Herbs* being endued with a *vegetating virtue*, as well as *Animals*, which propagate themselves by a moist *Seed*, do transfuse the *generating virtue* and *vital spirit* from one to another by mutual embraces, and this by a tacit consent of nature, and are cherished, animated, flourish, and produce *Fruits* and *Seeds* by a hidden and secret inspiration.

Cucumbers and *Gourds* have an antipathy against *Oyl*; so that when ever it is put to them, they seem to turn away from it.

II.
Why Cu-
cumbers
and Gourds
have such
an aversion
from Oyl

The Reason is, because the *Effluvia* that proceed from *Oyl*, consist of such particles, as do with their sharp prickles and points run into them, and cause their *Fibres* thereby to be contracted, so as that they seem to avoid, or withdraw themselves from the *Oyl*.

The same *Antipathy* is found between the *Ivy* and the *Vine*, insomuch that a *Cup* made of *Ivy* will not admit of *Wine*. For if we may believe *CATO*, if a *Cup* be made of *Ivy*, and be filled with *Wine*, if the same be mingled with *Water*, immediately the *Wine* will run out of the *Cup*. And it was probably for this cause that the *Ivy-tree* was consecrated to *Bacchus*, forasmuch as it resists *Drunkenness*, and removes pains of the *Head*, caused by too much drinking of *Wine*.

III.
Why the
Ivy hath
an Antipa-
thy against
a Vine.

Cabbage is said to abhor the neighbourhood of the *Vine*: And *Rue* to be an Enemy to *Hemlock*.

IV.
Why Cab-
bage is said
to be an En-
emy to the
Vine.

One

One *Plant* is said to be friendly or inimical to another, not by reason of any *Sympathy* or *Antipathy* that is between them: For such a concord or enmity is not to be found among *Plants*; but on the contrary when one *Plant* is nourished with the same kind of *Juice* that another is, their Neighbourhood becomes hurtful to one another, because then the one robs the other of his due *Aliment*. But if two *Plants* are maintained by a different *Juice*, then they are said to *sympathize* together, as *Rue* flourisheth, when planted near to a *Fig-tree*, because they draw a contrary *Aliment* from the *Ground*; the one of them taking in a moisture which gives it a *sweet taste*, and the other such as affords it a *bitter taste*. And it is for the same Reason that a *Rose-tree* which grows near *Garlick*, brings forth sweeter scented *Roses* than that which is in the neighbourhood of other *Plants*, because the noisome and offensive *Juice* being sucked in by the *Garlick*, the purer and more fragrant *Juice* is left for the *Rose-tree*.

V.
Why some
Herbs avoid touch-
ing.

The *Live Plant* so called, to which the *Arabians* and *Persians* give the name of *Suluc* or *Saluc*; and to which *Philosophers* have given the Title of *Chaste* or *Shamefaced*, if whilst it is *Green* it be touched never so slightly with ones *hand*, or be never so little squeez'd with ones *finger*, it presently starts back, and contracts it self; but no sooner is the hand of him that toucheth it withdrawn, but it returns again to its natural posture. And *THEOPHRASTUS* tells us, in the 4th Book of his *Histories*, Chap. 3. that there was a *Tree* growing about *Memphis* in *Egypt*, which to outward appearance was *thorny* and *prickly*, and its *Leaves* resembled *Fern*, the *Branches* whereof being touched, the *Leaves* immediately fall and wither, and afterwards recovering their strength, rise again and return to their former state, as is express'd in the *Figures*.

Figure
27.

HENRICUS REGIUS, in the 4th Book of his *Natural Philosophy*, endeavours to give a reason of this *Miracle*; supposing in the first place this *Plant* to be of a very tender and pliant substance, which upon the least touch is wounded and bruised. 2dly, That there are some inward *Nerves* or *Fibres* marked 1. 1. wider than other outward ones, sign'd 2. 2. by which means the *Stems* proceeding from the *Earth T*. are in more abundance sent up into the upper *Fibres* of the *Leaves b b*, than into the lower *c c*. For when a *Hand* toucheth the upper part of the *Leaves* about *d d* of the *Figure A*, the *Spirit* contained in those parts, are by the inward *Nerves* 1. 1. carried downwards, and consequently open the *Flap Doors* and *Pores* that are about 5 5, and pass out of the wide *Nerves* into the narrower 2 2. And forasmuch as they cannot go downwards, because they are hindered by the upward tending *Flappets* 6 6, they ascend, and in their ascent shut the *Flappets* 4 4, opening from the narrower *Nerves* to the wider, and thus necessarily pass to the inward *Muscles* or *Fibres c c*, and blowing them up, draw the *Leaves* downwards, as far as the *Joint* marked . . . reacheth, according to the situation and figure express'd *Figure A* and *B*. But afterwards when those *Leaves* are bent or prest downwards, and that the *Hand* be removed again from the *Herb*, then the said *Stems* do move more copiously out of the *Earth T* through the inward and wi-

der *Nerves* 1 1, and the ascending *Flappets* 3 3, than through the outward and more narrow 2 2, into the *Stalk*, and therefore first shut the *Flappets* that are about 5 5, and that lead from the wider and inward *Nerves*, to the outward 2 2; and proceeding further, enter into the *Muscles* of the *Leaves b b*, and blowing them up, do somewhat lift up the *Leaves d d* that before were prest down; and by this their lifting up of the *Leaves* do press those *Stems* which are in great abundance in the lower *Muscles* of the *Leaves b b*; which being prest, do open in the narrow *Nerves* 2 2, the *Flappets* 4 4 that lead from the outward *Nerves* to the inward, and pass into the broader and more inward *Nerves* 1 1; and there forasmuch as by reason of the copious *exhalations* ascending from the *Earth T*, and shutting the *Flappets* 5 5, which lead towards the narrow *Nerves*, they can neither descend, nor pass sideways, they are by those copious *exhalations*, which continually ascend into those wider *nerves*, necessarily determined, to the upper *Muscles* of the *Leaves b b*; and entering into them, together with *Stems* that ascend out of the *Earth* through the broader *Nerves*, they lift up the upper parts *b b* of the *Leaves* that are filled with these copious *exhalations*, but emptied with respect to their inward parts *c c*, and so reduce them to the same situation they had before, and the same that is express'd in the *Figures*.

But this contraction of the *Leaves* may also be assigned to *Cold*. For the coldness of the *Finger* represseth the spreading motion of the *Juice* in the *Nerves*, and in a good measure stops the influence thereof; whereupon the *Fibres* do immediately contract or draw in themselves, and at the same time bend the *Leaves* downwards: After the same manner as we find that *Cold* doth condense and wrinkle the *Skin* of our *Body*, whereas on the contrary, *Heat* doth extend the same. And the *Lappets* of the *Leaves* are drawn inwardly together, because probably the upper *Fibres* of the *Nerves* are drier, and consequently are more readily and sooner contracted; and the lower *Fibres* softer, and therefore do more easily give way to be extended. Now that this contraction is caused by *Cold*, may be gathered from some *Flowers*, which shut themselves in the night, as *Marygolds*, *Succory* and *Woodbind-Flowers*. So likewise we read of a *Plant*, the least *stalk* whereof, if it be wounded with a *Knife*, immediately the *Flowers* fall from it, because of the contraction or shrinking of the cut *Nerves* to which the *Flowers* are fastned.

Some *Historians* tell us of a *Tree* called *Pudifetana*, which cannot so much as endure the breath of *Man*.

The Reason of this may be, because the particles of the *exhalation* are so strongly driven against this *Plant*, that its tender *Nerves* are thereby dissolved, and their *Texture* disturbed. As we find that the tender *Bodies* of *Children* become sometimes infected by the *Breath* of an *Old Woman*.

Travellers who have visited the *Island* of *Japan*, do make mention of a certain *Tree*, which hath such a friendship with *Iron*, that if a *Branch* of it be lopt off, it may be joined and fastned to it again, by means of a *Nail* struck through it

7 E

VI.
Another
Explication
of the con-
traction of
Leaves of
the Sensitive
Plant.

VII.
Why the
Pudifetian
Tree abhors
the Breath
of Man.

VIII.
Of a Tree
in Japan,
that hath
sympathy
with Iron.
into

into the *Tree*, and flourish again as much as ever. Yea if the *Tree* begin to decline or wither, it presently recovers as soon as *filings* of *Iron* are laid to the *Roots* of it.

Supposing this Relation to be true, this effect does seem to be attributable to nothing else but to the indented *particles* of *Iron*, which do open the *pores* of the *Root*, and so cause the *Alimentary Juice* to pass up more freely into the *Stem* of the *Tree*. And forasmuch as some of these *particles* do continually break forth from the *Iron* of the *Nail* that is struck through the *Branch*, no wonder if by this means, the obstructions are taken away, and the ready passage of the *Juice* be furthered.

IX.
Why Maiden-
hair and Cab-
bage cannot
endure wa-
ter.

Maidenhair and *Cabbage* seem to abhor *water*, and to keep it off from themselves. And therefore if they be dipt in *water* they do not grow wet, but are taken up out of the *water* as dry as when they were dipt in.

The Reason is, the great smoothness of their *surface*, which is such, that it will not suffer any *water* to stick to it. For *water* cannot stick to any *Body*, except its *surface* have some small roughness or wrinkles, wherein the *liquor* may stick and be intangled. Hence it is that all fat and greasie things can admit of no *water* to stick to them, because *Fat* hath a very smooth *surface*, and doth render those things smooth that are besmeared with it. Or this quality in *Maidenhair* and *Cabbage* whereby they reject *water*, may be attributed to a very thin *Down* that covers their *Leaves*, such as we see there is in some *Fruits*, which gather all the drops of *water* upon their *points*, and keep them rounded there, so that they cannot penetrate any deeper, nor wet them except after a long lying in *water*.

X.
Why Water-
Mallows
seem to
have an
Antipathy
against
Lead.

A Man that hath dipt his hand in the *Juice* of the *Root* of *Water-Mallows*, *Purslain* and *Herb Mercury*, may put it into melted *Lead*, and receive no hurt thereby.

This proceeds from the natural coldness of these *Juices*, and also from the clammy thickness of them, which covers the *hand* as it were with a *skin*, and hinders it from being touched by the melted *Lead*. To which may be added, that they leave also a great smoothness upon the *skin*, which makes the *Lead* immediately to glide from it, so that the heat of it hath not leisure to penetrate the *pores* of it.

XI.
How Dittany
draws
any Iron
Weapon out
of a wound.

So great is the sympathy betwixt *Dittany* and *Iron*, that upon the touch of it *Iron Weapons* drop out of the *Wound* of any living *Creature*. According to what *TULLY* tells us in his 2^d Book de *Natura Deorum*: It is reported that the *Goats* in *Crete*, when they are wounded with *Arrows*, do seek for the *Herb Dittany*, which they have no sooner tasted, but the *Arrows* drop out of their *Bodies*.

Some have supposed this effect to be caused by a kind of *Magnetical Virtue* in *Dittany*, whereby it attracts *Iron*; but daily experience hath convinced this conceit of falsity. For this *Herb* when applied to *Iron*, exerts no *Magnetical Virtue* at all upon it. Conclude we therefore rather, that *Iron Weapons* drop out of the *Body* upon the eating of this *Herb*, because it makes the *Wound* wider, and opens the *Orifice* by its agitation of the parts of it; so that by this means the *Iron* either drops out, or is easily pulled out with the least touch. To

which may also be added the force or impulse of irritated *Nature*, which being assisted with the *particles* of the *Herb*, or some *Effluvia* proceeding from it, doth endeavour to thrust out that which is hurtful to it.

Those that have lived in *Virginia* tell us, that a sort of *Wild Pennyroyal* grows there, which is so hateful to a *Serpent* called the *Rattle-Snake*, that if the bruised *Leaves* be but held to the *Nostrils* of this *Serpent* for about half an hour, it infallibly kills it. And therefore this *Snake* is never found in those places where this *Herb* grows.

There are no *Plants* that have the power of driving *Devils* away. For *Bodily Substances* cannot exert any activity upon *Spiritual* or *Immaterial Ones*. And tho' some *Herbs* are applied to persons possessed, in hope to yield them some relief, yet must not we conclude from thence, that they have any power against the *Devils* themselves, for the reason above-mentioned.

XII.
Wild Pennyroyal is a great enemy to the Rattle-Snake.

XIII.
There is no such virtue in Plants whereby they can chase away Devils.

CHAP. VI.

Of the Original of Plants.

IT is believed that some *Plants* grow of themselves without *Seed*; such as *Asarabacca* which grows sometimes upon *Walls*; and a kind of *Maidenhair* which grows on the sides of *Wells* and near moist places. Besides, many other *Herbs* which of themselves sprout out of the *mould* that hath been deep dug out of the *ground*.

They who attribute the virtue of inferior things to the *Stars*, and suppose that nothing can be done upon *Earth*, without the concurring help of the *Heavenly Influences*, refer the original of *Plants* to the *Sun*, or any of the other *Planets* or *Stars*, as making them the *Authors* of all *Sublunary Generations*. And therefore such as these are of the opinion of the *Cabalists* who precisely assert, That there is no *Herb* or *Plant* here below, which hath not his *Star* in the *Firmament*, which strikes with its *Rays*, and bids it grow. But having before treated of the power of the *Stars*, and taken it for granted that our *Modern Philosophers* are not so weak as to attribute all particular effects to general Causes, we must look out elsewhere for the Original of *Plants*.

Some are of opinion, that all *Plants* spring from the fortuitous meeting of some *Earthly particles*, as when the insensible parts of the *Earth* being agitated in the upper Crust of the *Ground* by the subtil matter do acquire such a figure, together with such a situation and motion, as is necessary for the first formation of the *Plant*: And from whence, as to the foundation, all the other parts afterwards are reared, whilst the *Nutritious Juice* mounting up through this first Rudiment of the *Plant*, doth dilate the parts, and assigns a certain figure to them. They suppose indeed that the Generation of *Plants* is somewhat Analogous to that of *Animals*, viz. when *Plants* do arise or spring from a *Seed* sown: Because the *Seed* in this case resembles the *Egg* of *Animals*, as consisting of a *Bud*, a *Shell*, *Membrans*, and a *Yolk*. Yet with this difference, that the distinction of *Sexes* is not requisite to the generation of a *Plant*, because every *Plant* gives forth its *Seed* in the *Fruit* it produceth; which *Seed* doth not stand in need

I.
Whether
Plants
grow with-
out Seed.

II.
The opinion
of the
Cabalists.

III.
The opinion
of some
Philoso-
phers.

of a *Womb* to receive and cherish it, since the *Fruit* it self supplies that place. But yet for all this they suppose also that *Plants* may be *Generated* without either *Root* or *Seed*.

IV. *Herbs* sometimes grow on the surface of the *Sea-water*. For they observe with the *Antients*, that *Herbs* grow on the top of the *Sea*, and that these are the product or effect of the coagulated *Sliminess* of the *Water*, wherein the heat of the *Fire* is most predominant, and the *Sea* moves more slowly than in other parts of it. Yea there are some who have made it their observation more than once, that *Herbs* have sprung out of *Snow* that hath been kept a long while, which *Herbs* they have found to be of a bitter *Taste*. Neither can this be any matter of so great wonder to us, when we find that *Worms*, not much unlike those which are generated in our *Bodies*, are sometimes generated out of *Snow*, as some ingenious persons in *Germany* have lately observed.

V. *From calcin'd Earth* several *Plants* have been produced. Others again have observed, that *Herbs* have sprung forth from burnt or calcin'd *Earth*, especially after it hath been watered with a copious *Shower*. Because by the power of *Heat*, the particles of *Bodies* are as it were let out of their prisons, and joining variously together, do form the *Rudiments* of *Plants*; which the moisture doth further unite and work together. Now that in this *Earth* the *Seeds* of *Vegetables* lie hid, may be gathered from this, that if after it is burnt it be exposed to the *Air* and *Rain* again, it brings forth divers *Vegetables*.

VI. *By what means a Wood could spring up without the sowing of any Seeds*. *Historians* tell us, that a great *Wood* sprung up out of the ground in *Cyrene*, after the falling of great and copious *Showers*, which extended it self to many miles. And *THEOPHRASTUS* *Histor. Lib. 6. Cap. 3.* says that a famous *Tree* called *Laser* (which *PLINY* reckons amongst one of the excellent gifts of *Nature*, as being of great use in many *Medicinal Compositions*, and strengthening concoction in *Old Men* and *Women*) sprang out of the *Earth* in those parts, after a shower of *Rain*, whereas before it had been there altogether unknown.

Some imagine that this great *Wood* and useful *Tree* did not spontaneously, or of themselves spring out of the ground, but from *Seeds* carried thither by the *Winds*. But they suppose there is no necessity to grant this, forasmuch as *THEOPHRASTUS* tells us, that the ground in *Crete* can scarcely be turn'd up, but that *Cypress Trees* do spring up from it, and this not from any foreign *Seeds* conveyed thither, but because the ground there abounds with particles, which, when exposed to the *Air* and agitation of the *Sun Beams*, do form the *Rudiments* of those *Trees*. And the reason, say they, why the same doth not happen in other ground, is because the particles of *Seed*, cannot be so mingled and grow together, as is necessary to form the first organization of those *Plants*. For it is a thing notorious beyond all dispute, that every ground is not proper to bring forth all manner of *Plants*; for we see that those *Plants* which grow in great abundance in both the *Indies*, *Brazil*, *Arabia*, &c. will not grow in *England* or *Flanders*, or other northern parts of the *World*. Yea in one and the same *Country* some *Plants* grow in one part, and not in the other of it, according to the peculiar quality and disposition of the ground. So that they suppose that *Woods* may

be generated, not only by the *Industry* of *Man*, or by *Seeds* carried by the *Winds*, but from particles found in the ground, which by heat may be so disposed, as to shoot up into different *Plants*.

Wherefore it cannot seem strange that on the *Dikes* that are cast up in the *Isle of Ely* for the draining of the *Fenny Grounds* such vast quantities of *Mustard Seed* should grow, tho' never any known in the memory of men to have grown there before. So likewise after the Dreadful *Fire* of *London* great quantities of the *Narrow Leav'd Neapolitan Hedge-Mustard* was known to grow in the *Ruins* of this *City*, according to the relation of many *Credible Authors*, whereas for many hundreds of years the ground had been built with *Houses*, nor ever any such *Herb* was known to grow there, so that it must be concluded, that either this *Herb* did grow of it self there, or that it grew up from *Seeds* that had so long been hid in the ground, which none will easily admit.

But all difficulty will be removed as to this point, if we consider how *Plants* grow upon *Walls*, the tops of *Houses* and *Rocks*: To which places it is not easie to be conceived how any *Seeds* should be conveyed; and therefore it seems most obvious to conclude, that they proceed from large and plentiful *Showers*, which leave some slimy matter upon the said *Walls* and *Rocks*, which being cherished and assisted by the *Sun's Prolifick Heat* doth bring forth *Herbs*. It cannot be doubted, but that many particles of the *Earth* do mingle themselves with the *Steams* that do continually ascend from it; which afterwards when the said *steams* or vapors are turned into *Rain*, fall down again, and cleave to rough *Bodies*, and when the water is again rarefied into vapor, do remain behind upon the said *Bodies* in the form of *Slime* or *Mud*, out of which afterwards many *Plants* do bud.

But notwithstanding all these *Reasons* and *Experiments*, our modern *Philosophers* believe that all *Vegetables* are formally contained in their *Seeds*, and that they are not formed by apposition of parts as *Stones* and *Metals* are, but at once and all together like perfect *Animals*. They cannot imagine how the fortuitous concurrence of divers particles can form that vast number of similar parts as well as *organical*, which enter the composition of every *Plant*. Neither can they any more conceive how the pores of the grain of *Seed* that is cast into the ground should be so disposed, as that the *Juices* which penetrate them, should of themselves range themselves into that order, wherein consists the form of each *Plant*. Wherefore they conclude that all *Plants* were formed together and at once, and that they are so comprised one in another, that the latter are only an uncasing or unfolding of that which was contained in the first *Plants*.

Accordingly we see that a *Bean* contains formally the *Root*, *Stalks* and *Leaves* of the other *Bean* that is to grow from it; which therefore makes it probable that this 2^d *Bean* does again contain a 3^d, and this 3^d a 4th, and so on to an infinity. So that we are to consider the growing of *Plants* only as a repetition of *Generations* performed every year, by the production of new *Leaves*, *Flowers* and *Fruits*, whose *Branches* actually contain an infinity of others; and to conceive that of all the *Leaves*, *Flowers* and *Fruits* that are actually formed in the *Branches*, there be only

VII. *Hedge-Mustard* grows without *Seed*.

VIII. *How Plants grow upon the tops of Houses and Rocks*.

IX. *All Plants proceed from Seeds*.

X. *This confirmed by the instance of a Bean*.

only a certain number that can be unfolded every year.

XI.
Malpighi-
us's Expe-
riment to
this purpose.

MALPIGHIUS designing to make a trial whether *Earth*, without being sown with any *Seed*, could bring forth *Herbs* of it self, put some *Earth* which had been dug deep out of the ground into a *Glass Vessel*, and bound over it a manifold doubled piece of *Silk*, so as that the *Air* and *Water* might pass through it to the *Mould*, and yet keep off those small *Seeds* that are carried up and down in the *Air*; but he could never find that any *Herb* ever sprouted in the said *Glass*.

XII.
God is the
Author of
the first
Plants of
every Spe-
cies or Kind.

So that we must conclude that the first *Plant* of every kind was at the beginning produced by *God*, when he divided the matter of the *World* into parts of that exact bigness and figure, as they were to be in order to their composing the *Buds* of each kind of *Plants*. But not that they were produced according to the before-mentioned opinion of some *Philosophers*, from the fortuitous concurrence of many principles, which so united themselves together, as to form such a *Plant*; for if this were so, we should see sometimes *Plants* of new kinds produced, which never hapning, we must conclude, that *God* is the Author of the first *Plants* of each kind.

XIII.
The cutting
or lopping
of Plants
conduces to
the con-
servation
of them.

Plants that are frequently cut, cropt or lopt, do grow the better, and live so much the longer.

The Reason is, because frequent *Amputation* doth renew the *Juice* of the *Plant*, by keeping it from spending it self too much in luxuriant and supernumerary *Branches*. So that *Plants* that are wont to live one year only, if they be not cut in time, when they are duly cropt, will outlive that time; such as *Lettice*, *Purslain*, *Cucumbers* and the like. And as to *Trees*, we find that such as are not used to be lopt, do never attain to the tallness of other *Trees* of the same kind, on which *Amputation* is celebrated.

XIV.
Why Plants
growing in
different
places, are
endued
with diffe-
rent pro-
perties.

Plants that grow in the *Philippine Islands* are indued with different qualities, and as they are planted or grow towards several quarters of the *World*, they are accordingly indued with various affections. For those *Leaves* which grow towards the *East* are good and healthful; whereas those which grow towards the *West* are poisonous and deleterious. So with us, those *Apples* that grow near those places where there is great store of *Cabbage*, yield a strong and stinking smell.

The Reason is, because some *Effluvia* do exhale either from the *Earth*, or some neighbouring *Plants*, which impart some noxious qualities to the *Leaves* and *Fruits* of the said *Trees* or *Plants*. For it is notorious, that poisonous *Trees* or *Herbs* do communicate their venom to *Bodies* that grow near them. Because the ascending vapors carry always somewhat of the same *Earth* along with them, from whence they ascend; and young and tender *Plants* that grow near to stinking or noxious, are easily affected and infected by them.

XV.
Plants are
endued
with the
qualities of
the Nutri-
ment they
take in.

Thus we see that the *Wine* that is made of the *Grapes* of a *Vine* that hath had *White Hellebor* or *Herb Mercury* grow near it, becomes purgative: And in like manner, that the *Fruits* of any *Tree* become *Narcotick*, *Venomous*, *Diuretick*, &c. if their *Roots* be moistned with such like *Juices*. Wherefore to make *Plumbs* purgative, it is a common thing to bore several holes in the *Trunk* of the *Trees*, and put into them the *Juice* of *Hellebor* or

Colloquintida, by which means their qualities are imparted to the *Tree*.

It is a matter of common Experience, for *Plants* to grow wild, and degenerate from what they were. Thus a *Fig-tree* degenerates into the *Wild Fig-tree*, *Barley* into *Oats*; besides many other such like *Transmutations*.

This degenerating of *Plants* proceeds either from the negligence of the *Husbandman*, the situation of the place, or the quantity of the Ambient *Air*. For *Plants* grow wild, except they be set in places that are fit and suitable to them, and that they be so cultivated as their Nature doth require. Which tho' it is evident in many *Plants*, yet in none more than in *Violets* set or sown for encrease, which if they be not every 3 years transplanted, do degenerate into a pitiful *Flower* without any scent at all.

The Reason of which deficiency is, because the Rudiments of *Plants* in their first original do require a certain determinate matter, out of which their texture and disposition of *Plants* must be produced. And forasmuch as such matter is not to be met with in all places, where the *Seed* is sown, it is no wonder if the *Plants* in such ground do degenerate and become changed into others. For this change is not made in the *Root*, but in the *Seed* it self, whilst it doth not find convenient and suitable matter, or when by reason of old age, having lost its vigor, it must necessarily change its nature. Hence skilful *Gardeners* are wont to make trial of the goodness of their *Seeds* by putting them into boiling water, which if they be lively and vigorous, will in an hours time begin to sprout.

Amongst the Rules that are given by the *Antients* for the setting of *Plants*, this is one; that care be had that the *Plants* removed from one place to another, be set so, as that their parts may answer to the same quarters of *Heaven*, as they did in their former station.

The Reason is, because when the aspect of *Trees* is changed from one quarter of the *Heaven* to another, the inward disposition of the parts is changed together with it, and the passages whereby the nourishment is conveyed, are altered, and acquire another situation. For if any will make the Experiment by cutting the stem of a *Tree* grown in an open *Field*, with a *Sicbe*, he will perceive several *Circles* that are broader towards the *South*, and narrower towards the *North*. Which cannot be ascribed to any other cause, but to the *Heat*, which proceeding more copiously from the *South*, doth more strongly agitate the particles of the *Tree*, and more extends the Veins of it, than that warmth which comes from the *North*. And tho' this difference be not to be found in *Brazile-wood*, all the *Circles* whereof are Concentrical, and at an equal distance from each other, the Reason is, because in the *Torrid Zone* *Trees* receive an equal degree of heat from the *North*, as from the *South*. Hence it is that from the position of these *Circles* some have taught how to find out the *Meridian*: And the more skilful *Gardeners* and *Husbandmen* enjoin transplanted *Trees* to be set with the same respect to the quarter of *Heaven*, which they had in their former position.

XVI.
What is the
reason of
the degene-
rating of
Plants.

XVII.
Why the
quarters of
Heaven to
which the
parts of a
Plant were
directed, is
to be obser-
ved in the
transplanting
of them.

CHAP. VII.

Of the Nourishment of Plants.

I.
How the
Root grows
and is en-
creased.

AS soon as that part of the *Sprout* which is to constitute the *Root*, is become such, we perceive presently that it is nourished and encreased as to all *dimensions*, that is, in *Length*, *Breadth* and *Depth*.

The Reason is, because the *Juice* of the *Earth* passing through the thin *Skin*, doth some part of it enter into the *Bark*, and in part also into the *Woody Fibres*. Now that which enters into the *Fibres*, doth by little and little mount upwards, as well by reason of the agitation it hath received from the *Sun*, or from some *Fermentation*, as from the *circular motion* of the *Earth*; according to which every Body that is so moved, strives to withdraw from the Center of its Motion. Now proportionably as this new *Juice* mounts upwards, it must of necessity pass from the *Woody Fibres* into the *Bladders*, where meeting with the old *Juice*, it by commixtion therewith produceth a *Fermentation*; from which, as from all other *Fermentations* in *Chymistry*, certain *concretions* are produced, which at the same time do encrease the dimensions of the *Bladders* and of the *Woody Fibres*.

II.
Dunging of
the grounds
conduceth
much to
their bear-
ing or
fruitfulness.

To the end that *ground* may be the more fit to bear *Plants*, it is *dunged* before the great *Rains* begin to fall. For the Barrenness of *Vines*, *Wheat* and other *Corn* is overcome by *Stercoration*.

The Reason is, because *Dung* abounds with *Salt*, which being dispersed through the Pores of the *Earth* doth allay the moisture and coldness of it, and promotes growth or *germination*. For the life of *Plants* consists in *heat* and *moisture*, whereof the one is the *Agent*, and the other the *Patient*; yet sometimes it may so happen, that *dunging* of ground may do more hurt than good, viz. when there is no moisture to rot the *Dung*, and dissolve the *saline parts* of it. Hence it is common with *Husbandmen* to *dung* their grounds at such a season, when they have reason to expect there will be copious *Rains* to dilute it, as before the beginning of *Spring*, or towards the latter end of *Autumn*, to the end that the moisture having dissolved the *Salt* that is in the *Dung*, it may be conveyed by this vehicle of the water to the inmost pores of the *Roots*. For otherwise the *Corn* that is sown will be in danger of being burnt by heat, in case the *Salt* be not dissolved, or that the surface of the ground be overmuch cumbered with abundance of *Dung*. And therefore it is *PLINY's* observation, *Lib. 18. That Fields, if they be not dunged, are too chill and cold; and when over dunged, are burnt up.* For there is a great difference between the *dungs* of several *Animals*; for *Pigeons Dung* is the hottest of all, and next to it *Sheeps Dung*, which two are only proper to recover those grounds that are chil'd with over-much cold and crudity. *Hogs Dung* is of a sharp and biting nature, such as is found in *Onions*. But the *Dungs* that are more moderate, and of a middle nature between these, are *Horse Dung*, *Asses Dung* and *Cow Dung*.

III.
Dung con-
duceth to
the encrease
of Plants.

By this means the life of languishing, and almost dead and withered *Trees* is recovered and restored, viz. by laying *Dung* to the *Roots* of them.

Hence the *Grain* called *Panick*; which is so called from the *Panicula* or *Beards* it is armed with, if it be laid to the lower part of the *Root*; it is known to be of good use to promote the growth of the *Tree*: For being of a clammy and spongy substance, it sucks in the moisture of the *Earth*, and so furnishing the *Root* with copious nourishment, it dilates and makes it grow.

In like manner some tell us, that the *Stones* of *Grapes*, laid in great quantities to the *Roots* of *Vines*, do greatly conduce to their thriving and encrease: Because these *Stones* are furnished with pores suitable to admit the *Juice*, which serves for nourishment to *Vines*, which after they have sucked good store of the said *Juice*, communicate the same to the *Roots* of the *Vine*.

Fallow Grounds, that is, such as are only tilled every other year, are more fruitful than such as are sown continually; and are the more fruitful, the longer they have been suffered to lie fallow, especially without soiling.

The Reason is, because by tilling, the pores of the *Earth* are opened, by which, as through so many, on purpose prepared passages, the *Juice* is carried upwards into the *Air*. Whereas in fallow grounds, the said pores are shut up, and there is no way for the *steams* to escape. And for the same reason it is, that *Husbandmen* burn the surface of the *Earth*, because when the *Stubble* is burnt after that the ground hath been reaped, the watry parts fly away, and the solid substance that remains is dissolved by the moisture of the *Earth*, which by its thickness promotes the fruitfulness of the ground. And therefore *VIRGIL* tells us in the First Book of his *Georgicks*,

*From burning Barren Fields, oft plenty comes,
When brittle Stubble crackling Fire consumes;
Whether from this, new force and nourishment
The Earth receives; or else all Venom spent
By Fire, and scorb superfluous moisture sweats.*

A Level Field is more proper to nourish Herbs and Plants, than a hanging ground; for it is observed, that those which grow in this latter do very seldom arrive at their due magnitude.

For seeing that *Salt* doth greatly conduce to the nourishment of Plants, the same is easily dissolved in a hanging ground, upon the falling of *Rain*, and is carried downward, without any, or very little profit to the ground. Whereas a plain or level ground, besides that it keeps all the *Salt* that is laid upon it, for to improve it, receives the fatness which is conveyed to it, together with *Rain* from other places. Hence it is that some assure us, that *Sea-weed* being laid to the *Roots* of *Cabbage*, do promote their growth, which can be ascribed to nothing else, but to the *Salt* which abounds in the said *Sea-weed*, and therefore imparts fruitfulness to the ground.

Cucumbers become tender and delicious by steeping their Seeds in *Milk* before that they be sown. The Experiment might very probably be of use if applied to the Seeds of *Artichocks* and other Plants, for the taking away of their harshness and bitterness.

The cause of this change may be, that upon the steeping of the Seeds in *Milk*, the *Fibres* which

IV.
The Stones
of Grapes
promote the
nourishing
and en-
crease of
vines.

V.
Why Fields
that have
lain fallow,
are more
fruitful
than such
as are con-
tinually
sown.

VI.
Why Herbs
grow better
in a level
Field than
on hanging
ground.

VII.
Cucumbers
are made
tender by
steeping
their Seeds
in Milk.

are formed in the *Roots*, take upon them such a *Figure*, and such *Texture*, as to give way only to such *particles* which constitute *sweetness*, and to reject all other thicker *Juices*. Whence it is that those who endeavour to advance the smell of *Flowers*, and exhale it by *Art*, order the *Rose-trees* to be planted near *Garlick*, which draws to it self all the nasty stinking *Juices* of the place, leaving the sweeter and more refined to serve for nourishment to the *Rose-tree*.

VIII.
The steep-
ing of Seeds
cannot pre-
judice the
goodness of
the Plant
or Tree that
comes from
it.

Neither need we to fear lest the *steeping* of *Seeds* should be any prejudice to the goodness of the *Fruit* by over-hastning its *Ripeness*; since that always depends upon the vigor and virtue of the *Seed*, which the hasty or slow ripening of it are not able to change. And therefore this *Experiment* may be extended to all *Grains*, *Seeds*, *Stones*, *Kernels*, *Roots*, or any other things that are committed to the ground.

IX.
Why some
Plants
grow more
swiftly, o-
thers more
slowly.

Some *Plants* grow more slowly, or swiftly than others: For *Willows*, *Vines*, *Gourds*, &c. encrease much in a very short space of time, and more especially *Gourds*, which grow to that bigness, that according to *PLINY*'s relation, they can scarcely be carried. Whereas on the contrary, the *Oak*, *Medlar*, and other such like, admit of very slow encreases.

The Reason of this difference is, because the nourishment of *Plants* depends on their *Juice*, which from the *Roots* is driven through the *pores*, as through so many little *veins*, which it fills to that degree, that they swell big with it, and are not able to contain all the *particles* of it. And forasmuch as the sides of the *pores* are too hard to be extended by the *Aliment*, therefore it is that their encrease also is very slow, and sometimes that they altogether cease from growing, according as it happens to *Old Trees*, which receive no encrease from the matter that comes to them, but continue at a stand. But *soft Bodies*, having pliant *pores*, and such as are easily penetrable, it is no wonder if the *Plants* that are so qualified are of swift and great encrease. Hence it is that *Gourds* grow to that vast bulk in the *East Indies*, that as *SCALIGER* saith, some of them are of 13 *Palms* breadth, and such as a *Porter* is not able to carry.

X.
The South
Wind fa-
vours the
growth of
Plants.

Plants are very vigorous when a *South Wind* blows, and advance more in growth than when other *Winds* bear sway.

For seeing that the *South Wind* is warm, and brings many hot *Exhalations* along with it from the *Torrid Zone*, it readily opens the *pores* of the *Plants*, and causeth the nourishment to mount up more copiously out of the ground, and to be distributed through all their parts.

XI.
Why
Plants do
not grow in
the Winter.

On the contrary, *Trees* do not grow in the *Winter*, because the coldness of the *Season* fixeth and congeals the *Juices* in the *pores* of the *Earth*, and consequently deprives the *Trees* of their nourishment.

XII.
Some Trees
are set to-
wards the
Meridian.

Those *Trees* which delight in the warm *Sun*, such as the *Plumb Tree*, the *Fig Tree*, the *Vine*, the *Apricock*, and such like, are commonly set upon a *Bank* or *Wall*, facing the *South Sun*.

The Reason is, because a double convenience accrues to these *Trees* from this position or situation. The first is, that the warmth of the *Wall* caused by the reflexion of the *Beams* of the *South*

Sun, doth greatly cherish and promote the growth and fruitfulness of these *Trees*. The 2^d is, that they keep off the shade: For when *Trees* grow round, that is, with their *Branches* spreading circularly, the upper *Branches* do shade the lower, but being spread against a *Wall*, this inconvenience is prevented.

The Famous *VAN HELMONT* put 200 pounds of *Earth*, dried in an *Oven*, into an *Earthen Pot*, and set in it the stem of a *Willow* of about 15 pound weight. After the time of 5 years he took up the *Willow*, and found it to weigh 165 pound, whereas the weight of the *Earth* was not above two ounces diminished, and had only been watered with *Rain-water*. And in another place of his *Writings* he tells us, that many *Fishes* live upon *water* alone, and particularly supposeth the *Salmons* to do so.

This encrease does not proceed only from, the substance of the *water*, but from the *Nitrous* and *Aerial Ferment*, which furnisheth *Plants* and other *Bodies* with their nourishment. For whenever a *Plant* wants this, it becomes altogether unfruitful. For we must not suppose that *water* is a simple *Body*, but consisting of many *Heterogeneous particles*, as may be easily proved from this, that *water* is subject to *putrefaction*, which it could not be in case it were simple, and devoid of all composition.

If an incision be made in a *Wild Tree*, and a *Graft* taken from a set *Tree* be *Ingraffed* into it, by this means the *Fruit* is meliorated, and of wild and harsh, becomes mild and delicious. And the same happens also, if the *Scion* be taken out of the same *Tree*, into which it is afterwards *Grafted*.

The Reason of this seems to be, because the *Fibres* of the *Ingraffed Scion* do not so perfectly correspond with the *Fibres* of the *Tree*; and the *Juice* which passeth from the latter, cannot freely enter into the former; because the ranging of the *pores* is changed, and so other ways must be prepared for the conveying of the alimentitious matter: So that by this means the *Aliment*, as it were, undergoes a 2^d digestion in another *Stomach*, and the occurring *Juices* are wrought or elaborated after a new manner. Hence it is that the *Fruit* growing upon a *Garden Scion*, grafted on a *Wild Tree*, becomes meliorated; because the *Alimental Juice*, which ascends through the parts of the *Plant*, having been already digested in the first *Stomach*, is sent into the second to pass through a second *Concoction*. And if any body will take the pains to multiply the said incisions, and graft a second or a third *Scion* upon the first, he will find that by every insertion the *Fruit* will attain a higher degree of melioration, because the *Alimentary Matter*, passing through so many different *Strainers*, is the more exactly prepared, and higher exalted and purified. An Example whereof we have in the History of *CORRELLIUS* a *Roman Knight*, who, when he at his *Country House*, near *Naples*, ingrafted upon a *Chestnut Tree* a *Scion*, taken from its own stock, it brought forth a *Chestnut*, much exceeding the common in goodness, and which afterwards were called from his name *Corellianæ* or *Corellian*; and when afterwards a *Freeman*, whom he had made his *Heir*, had *Ingraffed* the same a second time, it did not bring forth *Chest-*

XIII.
Water is
turned into
the sub-
stance of
Plants.

XIV.
How Fruits
become me-
liorated by
grafting.

nuts

nuts in that plenty as before, but much better than the *Corellian*.

XV. But the contrary happens when we cut off a Branch or Twig from a Grafted Tree, and put it into the ground.

The Reason is, because this Branch being put in the ground, and taking Root there, doth draw all its nourishment from thence only, which is prepared by one continual percolation or straining: And for this Reason brings forth less and worse Fruits than the grafted Tree whence it was taken; because in it there is a double concoction of the Alimential Juice, viz. in the Stem or Stock into which the Scion is grafted, and in the Scion it self; whereas in the Branch cut off from the graft, there is but one digestion or preparation of the Aliment.

CHAP. VIII.

Of the Germination, Sprouting or Budding of Vegetables.

I. THE Germination of Vegetables is that whereby the Bark, Leaves or Branches do send forth Buds, Fruits and Seeds, by a propagation of their Fibres. And so in a like manner a Seed is said to Germinate or Sprout, when the outward shell of the Seed is burst open by the breaking out of the Bud which appears above ground.

II. It is natural to all Vegetables to send forth their Buds upwards, tho' they be sown in a hanging ground; whereas on the contrary, the Roots of Plants tend downwards, and are but seldom seen on the surface of the Earth.

It will not be difficult to give a reason of this, if we consider how the Germination or Sprouting of Vegetables is performed, and by what means the Seminal Virtue presseth through the surface of the ground. For seeing that Germination is nothing else but a kind of Dilatation of a Plant, caused by the entrance of the Juice, which makes it swell, distend it self, and to sprout or break forth upwards: And forasmuch as no Expansion can be without heat, it is evident that the Bud which breaks forth from a Plant, doth proceed from heat, by the impulse whereof it is also carried upwards. For the nature of heat is always to mount upwards, and to drive all the Bodies it meets with, that way. And the reason is the same with regard to those Vegetables which grow on a downhill: For as fire that is kindled in a shelving or hanging place, doth not follow the declination or declivity of the place, but mounts up directly: So Plants that grow on the sides of Hills, do always tend upwards, as being directed and carried by the heat which always keeps that course. True it is, that for the same reason it seems that the Root also ought to mount upwards, forasmuch as it is likewise dilated by heat, and so it would without doubt, but that it is swayed downwards by its Aliment which is in the Earth, to which it tends. For as the flame of a Torch doth insensibly sink downwards, to feed upon the Wax, and to carry up the same to the upper parts: So the heat which is contained within the Roots, tends to the lower parts of them, where it draws in that

nourishment, which it afterwards sends up to the Stem, Branches and Leaves, for their support and growth.

Watry and moist Fruits, as Pease, Cherries, Gooseberries, Currans and Strawberries are the first that are Ripe.

The reason is, because the watry Juices are always the first that mount upwards, forasmuch as their smooth and even figures make it easie for them to separate themselves from others: Seeing therefore that Pease, Cherries, &c. contain more of this watry Juice, and are more nourished by it, therefore they must needs be ripe before other Fruits.

All Vegetables that have round or bulbous Roots, that is, such as consist of Coats or coverings one above another, as Onions, Aloes, Herb Pennywort, Saffron, Squills, Leeks, &c. do shoot and grow, tho' they be taken out of the ground, and hung up in the Air within doors.

The Reason is, because bulbous Plants do not suck their Aliment out of the Earth by the strings of their Roots, as other Vegetables do; but draw it in from above, viz. that Juice which lies hid in their Bodies, and those thick Coats wherewith they are covered; whence it comes to pass, that these Roots, being filled with moisture, and containing much alimentitious humours within their Membranes, whensoever the same is excited by heat, they begin to shoot forth. And that this is so, daily experience teacheth; for when bulbous Plants grow, their Roots are sensibly diminished, because the Juice, which swell'd them up before, becomes by degrees exhausted, and turns into Stalk and Seeds; as it is evident in Pennyroyal and Orpin, wherewith some Country People adorn their Chimneys, by tying them to little Lathes, on which they grow and continue green for a great while. But most of all is this visible in Houseleek, which will bring forth Leaves and Branches 2 or 3 years together, if its Root be only wrapt up in a Linnen Rag dipt in Oyl, and be renewed every half year.

It is observed concerning the American Aloes, with indented or saw-like Leaves, that every year some of its Leaves do wither, and as many grow in the stead of them, tho' it be not sprinkled with Oyl, but only wrapt up in a Red Cloath, and so hung up in a Kitchen.

The Reason is, because the alimentary Juice in this Plant does continually circulate from the Root to the Leaves, and from them again to the Root. For how else could it be, that the Root continuing undiminished, so much nourishment should be furnished for the production of new Leaves, except the said Juice were continually pushed forwards from the withered Leaves to the Root, in order to a new Production?

If the top of a Rose-tree, presently after its budding be cut off, it will bud, and bring forth Roses again, about the month of November following. Which sprouting doth not proceed exactly from the top that hath been cut, but from the shoots or twigs that grow near it.

The Reason is, because the Juice which is contained within the Plant, which otherwise would have gon to nourish the top of it, upon the cutting of it off, is conveyed to the Sprigs that grow about it, and from them produces Roses of a late growth.

III.

Why moist and watry Fruits are ripe soonest.

IV.

Why Onions sprout and grow tho' they be not set in the ground.

V.

Why some Leaves of the American Aloes fall off, and others grow in the stead of them.

VI.

How a Rose may be made to bud about November.

growth. And the same effect will be produced if you pluck the *Buds* of a *Rose*, as soon as they are first knotted. Yet it is probable that the budding of *Rose-trees* may be retarded, by tying a *Packet*, or other *Cord* very strait about the *Rose-tree*, because this ligature, will hinder the *Juice* from mounting so soon, as otherways it would.

VII.
Why a
Fir tree,
and other
such like
Trees, do
only send
forth
Branches
at their
tops.

Some *Trees* have only *Branches* proceeding from the tops of them, as the *Fir*, *Pitch-tree*, *Cypress-tree* and *Cedar*; whereas others shoot forth *Branches* from all parts of them.

The Reason of this different *Germination* of *Trees* is from the *pores*, by which the *Alimental Juice* passeth from the *Root* to the *Branches*; for if they be strait and perpendicular, the *Juice* is carried up along through them to the top, where the *Juice*, by reason of the great abundance of it, is forced to break forth, and to spread it self into *Branches*. To which also may be added, that the *Juice* which ascends in these *Trees* is fat and clammy. Whereas the *pores* of those *Trees* whose *Branches* proceed from all parts of their *Stems*, are more crooked and winding, by which means the *Juice* ever and anon breaks forth sideways. Or likewise, because their *Juice* is not so ropy and glewy, as it is in *resiniferous* or *rosin* bearing *Trees*: Wherefore as a great *Fire* or *Flame* which passeth up through a *Pipe*, with holes on the side of it like a *Recorder*, doth continually pass some of its parts through the said side holes: So the *Juice* in *Trees* being carried up through the *pores*, breaks forth by all the ways it finds open for it, and more especially through the tender *shoots*, the softness and tenderness whereof afford it a more easie passage.

VIII.
Why the
Leaves of
some Trees
are always
green.

The *Leaves* of some *Trees* and *Plants* are always green, as the *Bay-tree*, the *Laurel*, *Cypress*, *Ivy*, *Fir*, *Box*, *Rosemary*, &c. whereas others towards the end of *Autumn* lose their greeness, and are spoiled of the Ornament of their *Leaves*.

The Reason of the perpetual verdure of some *Trees* and *Plants* is, because their *Leaves* consist of a more solid matter, and do abound with such hot *Juices*, that the *pores* through which they run, cannot be shut up by the cold of the *Air*. And for this reason it is, that in *Brazile* all the *Trees* enjoy this privilege: And that in *Egypt* about *Memphis*, according to the account *THEOPHRASTUS* gives us, the very *Vines* and *Fig-trees* themselves never shed their *Leaves*, whereas others do lose their *Leaves*, and continue without them all the *Winter*, because their *Leaves* are more soft and tender, and therefore cannot resist the rigor of the cold, which contracts and draws their *pores* together, and by this means hinders sufficient *Aliment* from being conveyed from the *Roots* to the *Leaves*, which for want thereof, wither and fall to the ground.

IX.
Why tender
Shoots
are not fit
to be grafted.

Soft and tender *Shoots* or *Twigs*, and whose sides are not yet sufficiently hardened, are not fit to make *Grafts* of.

The Reason is, because in *Grafting* the *Fibres* of the *Scion* must be suited with those of the *Stock*, that the nourishment which comes from the *Root*, may have its free passage to both. For their *Orifices* must so answer one another, that the nourishment may pass from the *fibres* of the *Stalk* into those of the *Scion*. Now very soft and tender *twigs*, because of the tender texture of their *fibres*,

are so bound up and straitened between their *Rinds*, that they cannot readily take in their *Aliment*, and therefore thrive but badly, or wither within a short time. For the *twig* that is to be grafted, must be of a *years growth*, to the end it may the better cleave to, and unite with the *stock*. Thus on the contrary dry *twigs*, or which by reason of their Age or sapless, are also unfit for *grafting*, because they want *moisture*, by means whereof both their *Fibres* might be joined together, and become one *Plant*. As we see that dry and thirsty ground is *Barren*, and scarce able to quicken the *Seeds* that are committed to it.

Fruits when they are fully ripe, drop down from the *Trees* of themselves, and fall upon the ground.

X.
Why ripe
Fruits fall
from the
Trees.

The Reason is, because at that time, the lateral *fibres* of the *Fruits* do swell, and are no longer able to contain their *Aliment*; by which means it comes to pass, that that part of it which was used to ascend to the upper parts, finding no passage, runs downwards again, leaving the *stalk* by which it was fastened to the *Tree* dry and sapless. Hence it is that some *Fruits* fall down with their *stalks*, as *Apples*, *Pears*, &c. others without them, as *Plumbs*, *Apricocks*, *Peaches*, &c. according as the *Alimentary Matter* fails nearer to, or farther from the *Fruit*.

But the Reason why *Stags* cast their *Horns* every year, at a set season, doth not proceed, as some suppose, from the same cause now produced, but indeed from a quite contrary, viz. from an overgreat abundance of a volatile saline *Juice*, where-with *Stags* are filled at that time. For this matter continually flowing from all the parts of the *Body* of that *Animal*, and pushed upwards towards the *Head*, thrusts the old *Horns* out of their places; and being afterwards condensed by meeting with the cold *Air*, becomes turned into new *Horns*, and such as are more tender.

XI.
Why it is
that
Stags Horns
fall every
year.

CHAP. IX.

Of the Decay and Death of Vegetables.

PLANTS plucked up out of the *Ground* do wither; and tho' *Trees* that are cut down in the *Spring*, do seem to bud and grow, as long as they are suffered to lie upon the ground, yet they are no sooner taken from thence, but they by degrees wither and dye.

I.
Why
Plants dye
when they
are plucked
up out of
the ground.

Plants plucked out of the *ground* do not wither immediately, because the *Juice* doth not all on a sudden cease from flowing, neither are the *pores* so soon changed, but that the *Aliment* is still for some short time carried to their utmost *Fibres*. For *Vegetables* never die, till their *Juice* stagnates, and is no longer heated and agitated by the subtil matter. For upon the failing of heat all motion ceaseth, and consequently all *Germination* and *Nutrition* also, wherein the *Life* of *Plants* doth consist. And therefore *Plants* in the *Winter* season cannot properly be said to be dead; because, tho' they produce nothing, and there appears no sensible transmission of the *Alimental Juice*, yet it cannot be denied, but that it is still in them, because the self same dispositions remain in them, that are found in *Living Bodies*, and that their condition

tion is very different from those *Bodies* that are withered and dead.

II.
How it comes to pass that the Rose of Jerusalem, after it is withered, grows green and flourisheth again.

Moreover, it happens sometimes that the parts of *Plants*, as their *Leaves*, *Sprigs*, &c. which have been shrivel'd and contracted by *drought*, are again, by the return of their *Juice* and *Moisture*, distended and displayed, as is evident in the *Beards* of *Oats*, and in the *Plant* called the *Rose of Jerusalem*; the *Root* whereof, when dry and withered, if it be put into luke warm *water*, immediately distends it self, and displays its *Sprigs*, and this by means of the *moisture* which insinuates it self into the *pores* of the said *Sprigs*, and so swells and extends them.

III.
The Juice circulates through the whole Body of the Plant.

For it can no longer be questioned, but that the *Juice* hath its course or circulation in *Plants*, like as the *Blood* in *Animals*, as may be perceived more especially in *Lettice*, *Bastard Saffron* and the *Greater Celandine*, in which *Plants* the *Juice* never rests, but as soon as their outward *Rind* is taken away, runs forth continually as the *Blood* doth out of *Animals* when a *Vein* is opened. Besides, the *Juice* of *Plants* is not found in them disperse every where throughout their *Bodies* without any *Vessels* to contain it, seeing that *pipes* or *passages* are found in them, resembling the *Veins* of *Animals*. As may visibly be perceived in those *Plants*, whose *Juice* is *White*, *Red* or *Yellow*. The Principal Cause of which *Circulation* is, for that all here beneath, which partake of the *Circular Motion* of the *Earth*, strive to withdraw themselves from the *Center* of their *Motion*: For therefore it is that the *Juice* of the *Earth*, being entr'd into the *pores* of the *Root*, in the which it moves with the more ease than in the *Air*, endeavours to mount upwards, towards the higher parts of the *Plants*, and distributes its self to them, according to their several requirings, and that in such a manner, that the remaining crude Portion of the *Juice*, returns towards the *Root*, in order to receive there a new and further preparation.

IV.
Why Oyl is an enemy to Plants.

Oyl is very hurtful to *Plants*, as being always destructive to them, when it reacheth their inward parts. And the same is observed by *Chymists* concerning *Quicksilver*, which is deleterious to *Trees* when ever it enters into the *pith* of them.

The Reason is, because *Oyl* by its *fainess* doth so obstruct the *pores* of the *Plants*, that the *particles* of the *Alimentitious Juice* cannot pass through them: Whereupon the *Plants* wither and die for want of due *nourishment* to support them. And *Quicksilver* is a *poison* to *Plants*, because by reason of its *subtlety*, it pierceth into their inward parts, dissolves the *Texture* of their *Fibres*, and introduceth a new disposition of their parts. And when this is done, the *Alimental Juice* can be no longer strained as it ought, and thereupon the *Plant* must needs fade and die.

V.
Why some Winds are hurtful to Plants.

Trees sometimes wither upon the blowing of some *Winds*, and the young *Shoots* or *Sprigs* of them grow so dry and *sapless*, that they may be rub'd to powder with ones hand.

The Reason is, because these *Winds* abound with a *nitrous* or *vitriolick Spirit*, which invading the green and tender *Shoots* of *Trees*, do blast them with a consumptive infection, foras-

much as the tender *strings* or *fibres* which are like the *nerves* of the *Leaves* and *Sprigs*, become so compress'd and drawn together by the cold blast of the *Winds*, that they can no longer take in the *Aliment* conveyed from the *Root*. By which means the *Trees*, being deprived of all their *moisture*, become dried up, and die.

The top of a *Sprig* or *Shoot* sometimes withers, when yet that part which is near to the *Stem* continues fresh and vigorous.

This may happen from several Causes; either from an obstruction of the *pores*, or from some knot, or from a dissolution of the twisting of the *Fibres*: For by any of these means the nourishment is hindred from ascending after its usual manner, and from distributing it self to all the parts: Whereupon when the *moisture* which was at the top of the *Sprig* is exhaled, and the way stop'd through which other should come to it, it must needs wither and die.

Trees do often wither and die by being bruised, slit, bor'd, or by some other wound.

The Reason is, because by *contusion* the order of the parts of a *Tree* is disturbed and confounded, and the passages obstructed, through which the *nourishment* passeth, and is conveyed to the further parts. Whence it comes to pass, that those parts which are above the *contusion*, do waste for want of *nourishment*, whilst those that are below it are choaked with too great abundance of it. In like manner *Plants* die also by *splitting*, or some other kind of wounds, because in this case, the *Alimentary Matter* ceaseth from passing through its *pores*, neither can it be distributed as it was before. And whereas some *Trees*, as the *Pine*, *Fir* and *Turpentine*, when they are wounded do thrive the better; this proceeds from the great abundance of their *moisture*, part whereof being evacuated by the wound, the *Plants* being rid of that which was their Burthen, bring forth *fruits* with more ease, and in greater abundance.

Some *Plants* perish by too much heat, especially those that are young and tender, which are not yet sufficiently armed against the injuries of the weather. Others are destroyed by cold, and being seized with the *Frost*, die.

The Reason is, because the life of *Plants* consists in the temperature of *Heat* and *Moisture*, as hath been before-mentioned; so that *moisture* cannot continue long in a *Plant* without a mixture of *heat*; nor *heat* without *moisture*. Wherefore when either of these doth predominate, and destroy its compeer or fellow, the *Body* must of necessity die, and be deprived of Life. Young and tender *Plants* therefore are much sooner than others destroyed, because the outward *heat* doth easily penetrate their tender *Bodies*, and by putting their parts into too vehement an agitation, doth extract and consume the *moisture*, not only out of the *Stem*, but out of the *Roots* themselves: And forasmuch as the loss thereof cannot be restored from out of the *Earth*, because it is likewise parcht up with too much *heat*, the *Plants* must needs wither and die. Others again do perish by over-hard *Frost*, which by locking up and contracting the *pores*, drives away the *heat*; whereupon the motion of the *Alimentary Juice* ceaseth, so that the *nutrition*, and consequently the

VI.
Why the top of a Sprig or Shoot sometimes withers.

VII.
How Trees come to die by being bruised or bored.

VIII.
Why some Plants perish by Heat, and others by Cold.

the growth of the *Plants* must in time cease also, and all their *vital functions* be interrupted. And for the same reason it is, that *Plants* are often killed by *Winds*, which if they be very hot, do open and widen the *pores*, and exhaust the hidden *moisture*: Whereas when they are cold, they compress the *pores*, and by expelling the *heat*, do weaken and waste the natural strength and vigor of them.

IX.
Why Wild
Plants are
longer
lived than
those which
grow in
Gardens.

Wild Plants, and such as grow on *Mountains* and *Hilly Places*, are of longer continuance than those which are cultivated in *Gardens*.

The Reason whereof seems to be this, because the *Plants* which grow in *Gardens*, are frequently overcramp'd by the abundance of *Alimentary Juice*, which does extinguish, or at least weaken their natural *heat*. For since the design of *Gardening* is to bring forth goodly and early *Ripe Fruits*, the *Gardner* makes it his whole business to make his ground fat and fruitful; and is not at all concerned that his *Plants* be strong and long lasting, so they do but thrive and bring forth abundance of *Fruit*. Now it is certain, that the *pores* of *Trees* are widened by the too great abundance of the *Alimentary Matter*, and an easy way being thus made for the *vital moisture* to escape, the *heat* must needs vanish together with it. Another thing that shortens the *Life* of *Plants* is, because the *dung* which is made use of to improve them, lies round about them, and that not far from the surface of the *Earth*; and by this means it happens, that they do not strike down their *Roots* so deep in the

ground, as otherwise they would: Whereas the *Plants* that grow wild in the *Fields*, being surrounded with more hungry and dry *Earth*, where they meet with but little *moisture*, sink their *Roots* deeper into the *Earth*, to provide themselves a sufficiency of sustenance, and by this means grow much stronger, and more able to resist all outward injuries, and consequently endure longer. For it cannot be questioned, but that the spreading and thickness of the *Root* conduceth much to the lasting condition of *Plants*.

Hence it is that *Gardeners* observe, that those *Plants* die within a short time, that are watered with hot *water*: For tho' by this means their growth for the present seem to be promoted, and it makes their *Fruits* to be ripe the sooner; yet because the *Fibres* of the *Plants*, by this unaccustomed heat, are too much relaxed, and so take in too much *Moisture* or *Juice*, they are either quite choaked by the too copious affluence of the *Alimentary Juice*, or else their *pores* become obstructed by the bigness of the *particles* that come thronging in into them.

And as it is of ill consequence to *Plants*, if they be watered with hot *water*, so neither doth too cold *water* agree with them. And therefore skillful *Gardeners* take care to set the *Spring* or *Well-Water* they make use of for the watering of their *Plants*, in the *Sun*, that the coldness of it may be somewhat temper'd and allay'd, for fear otherwise it might be prejudicial to the growth and thriving of them.

X.
Why hot
Water does
destroy Plants

XI.
Why too
cold Water
is hurtful
to Plants.

The



Book. 2. Part. 8. Chap. 1.



The Eighth Part

OF THE

H I S T O R Y

O F

N A T U R E.

O F

A N I M A L S.

CHAP. I.

Of Animals which are commonly supposed to be of a Spontaneous Birth.

I.
Whether there are any Animals produced without Seed.

THERE is nothing more vulgarly taken for granted among Authors, than that certain Animals, particularly Insects, are generated without Seed, as Bugs and Lice out of Human Excretion and Filth; Book-worms out of Books, Wood-lice out of Wood, Moths out of Garments, and innumerable others, which, as they say, breed and are produced, without Copulation of different Sexes.

Some Physicians who pretend to be the only Inspectors into things of this nature, because they discern not with their Eyes, nor can any way comprehend the Causes which produce these Animals, call the formation of them *Æquivocal*, as if they sprang from different Principles, and their production had no manner of agreement with that of others; whereas indeed their Generations, by the same right as other Generations, are to be called *Univocal*; since they are effected by the same necessity, and no less than others, require a previous Seed and requisite Dispositions therein. For whatsoever in Nature is produced, proceeds from Seed, and nothing in the Earth is generated by Chance, or contrary to the Course of Nature. True it is, that that sort of Seed is chiefly internal, and not always appearing to the sight; but that there is such a Seed latent in those Bodies, is not to be denied, since we find that Lice, Bugs, Maggots, &c. are curiously wrought and formed, each in their kind, and exactly agree among themselves in similitude of parts. For there is nothing wanting to their perfection; and they may be said to be no less compleat as to their internal, than external parts. For who can imagine, that so great a variety of Members, so exact a Form of each, so wonderful a proportion and contexture of parts, should fortuitously, and by an accidental

Concourse of Atoms be produc'd, and that there should not rather be some necessarily determined Seed to bring them forth? For if we allow, for Example, that Dawes among Birds, or Cats among Beasts, are produc'd of Seed, as being too elaborately fram'd to be compos'd by an uncertain Agent, why may not the same thing be judg'd of other Animals, when as we may observe in them a Structure no less exact and curious, and Parts no less correspondent each to other?

But some Philosophers suppose, that Bugs, Lice, Maggots, and such like Animals are generated, while many seminal particles, as they call them, being agitated by a subtle matter or heat, are so disposed as to compose or constitute certain convenient Figures and Organs. For this motion, as they say, not rashly and by chance, but according to the Laws of Nature, and its Seminary Virtues proceed out of an aptly and well-disposed Matter, and determinated Heat; whereby it comes to pass, that the parts of the Matter so exagitated, not only conduce to the formation of the Heart and Veins, and the union of them with the Arteries, but also to compose the Principle of the Brain, the Sensory and Motory Organ of the Fibres, Nerves and Spirits, which things being first laid as a foundation, a farther progress is made to the forming of the perfect Instruments, those namely which contribute and are inservient to Sensation and the Local Motion of the Body.

To this production of Animals may be referred that which HECTOR BOETIUS makes mention of in his History of Scotland, namely, that on the Sea-side in some parts of Scotland, there is a sort of Bird ingendred of a certain Tree, that is, of the Fruit of it falling off and dropping into the Sea. The same thing or the like, he reports to be on the Sea-coasts of the Hebrides Islands, where such a strange kind of Production is said to be brought about two manner of ways. The one from Ships, or old Planks and pieces of Timber, which being left upon the Shore, and there remaining some time, breed from their corruption certain Worms or such like Insects, which discover-

II.
Every Animal is engendred of Seed.

III.
Of the breeding of Ducks or Geese from Trees in Scotland.

ing first *Feet*, then *Wings*, lastly *Plumes*, come at length to bear the similitude of *Ducks* or *Geese*, and like them take their flight up into the *Air*. The other is a *Hatching* as it were of certain little *Birds* out of *Excrescences* like *Snails*, *Cockles*, or some kind of *Shell fish* sticking to the *Sea-weed* that grows in those parts, which are therefore supposed to proceed from the *Fruits* of *Trees*, because they are chiefly hatcht about that time, in which the *Leaves* or *Fruits* of those *Trees* that grow by the *Sea-side* appear and drop into the *Sea*. And indeed if *Fruits* hanging on a *Tree* can breed *Worms*, *Maggots* and such like *Insects*, why may there not as well out of the same *Fruits* be bred such *Animals*, as like other *Birds* take wing and glide to and fro in the *Air*?

IV.
Fishes engendred of Dew.

I have been informed by Men of very good Credit, that if a *Hurdle* be plac'd over any *water*, whether a running *Stream* or standing *Pool*, and dewy *Turfs* be so laid upon it before *Sun-rising*, that the *Hearby-side* may be turned downward without shaking off too suddenly the drops of *Dew*, so many drops as afterwards upon the *Sun-rising*, and heating the *Turf* shall fall into the *water*, for many *Fishes* will be ingendred of them, and various, according to the diversity of the *Herbs* on which the drops of *Dew* fate.

Upon the truth hereof a certain Famous Man infers that from *Lakes*, *Rivers*, *Seas*, *Fishponds*, and all places in general, disposed to the ingendring of *Fish*, there are *Seeds* variously exhal'd, being conveyed through the *Air*, mixt and incorporated with the *Dew*, and falling upon the *Herbs*, are so cherish'd by the *Spirit* of them, and acquire such a disposition from them, that being receiv'd into the *water*, they are there form'd into these *Fishes*. In the same manner as from the *Dew* lying upon the *Leaves* of *Nightshade*, and warmed by the heat of the *Sun*, are ingendred *Worms*, as *SCALIGER* affirms; and as in *Chili*, a Province of *South America*, there grows a *Tree*, from whose *Leaves* small *Serpents* are said to fall.

V.
All Animals whatsoever are generated from the Egg.

Now, tho' it hath been from Antiquity to this day the general opinion, that divers *Animals*, particularly small *Insects* are produc'd only by corruption; It is of late plainly evinc'd to the contrary by many Experiences. For besides those which I have quoted in my *Institution of Philosophy* touching *Insects*, we see that *Butterflies* by Copulation, produce an infinite number of *Eggs*, from which are hatcht *Canker-worms* of all sorts. Whence we may conclude, that all those *Animals* which are thought to be spontaneously ingendred, which are found in *Cheeses*, *Fruits*, and other sorts of *Food*, proceed from real *Eggs*, or at least from something equivalent to the *Seed* that comes from *Females* after they have been impregnated by the Company of the *Males*.

VI.
How Serpents have been generated in a Mans Brain.

But *HOLLERIUS* in his 10th Book *De Morbis Internis*, Chap. 10. makes observation of a *Scorpion* bred in the *Brain* of a certain *Italian* by the frequent smelling of the Herb *Basil*. And *RAIMUNDUS* in his *Mercurius Italicus* affirms, that he found by experience, that the foresaid *Plant*, plac'd under a *Stone* in a moist place, within two days produc'd a *Scorpion*, which much at the same time, while he resided at *Siena*, a very rare and memorable accident confirmed. A cer-

tain Gentleman of *Siena*, wonderfully taken and delighted with the smell of this *Plant*, used frequently to snuff up into his *Nose* the powder thereof dried, but highly to his cost, for in a short time he died *Mad*; whereupon his *Skull* being open'd by a *Surgeon*, a *Scorpions Nest* was there found: And this might possibly be, in regard the *Scorpion*, being delighted with the smell of that *Plant*, creeps with a great desire to it, lodges in it, and haply feeds upon it, and may chance also to lay its *Eggs* in its *Leaves* and *Buds*: Whence it might easily happen, that the foresaid Gentleman might, together with the *Powder* snuff up into his *Nostrils* some of the *Scorpions Eggs*, which cherish'd by the heat of the *Head*, might well enough hatch young *Scorpions*.

So the *Ukrainians* are mightily infected, especially in a dry *Summer*, with swarms of *Locusts*, by reason these sorts of *Insects*, before they expire, leave each of them behind them 2 or 300 *Eggs* in *Autumn*, which afterwards by the next *Summers heat* are hatcht into *Locusts*, which unless they be swept away by the following *Rain*, or driven by the *Northberly Winds* into the *Euxin Sea*, spoil all the *Corn*, and inflict vast damages upon those *Provinces* through which they travail. Some there are, who, by diligent observation, have made this remark, that never any *Insects* are generated of the *Flesh* of *Beasts* or *Fish*, except they have been first *Fly-blown*, or tainted with the *Seed* of *Flies*; and consequently that *Vermination* in *Flesh* proceeds only from *Flies*, altogether like to those which afterwards breed in *Flesh*.

VIRGIL in his 4th Book of *Georgicks* affirms, that from a *Heifer* of two year old, having its *Nose* stoppt, and being beaten to death, its *Bowels*, after it is killed, being spread over its whole *Skin*, *Bees* are generated, provided this be done about the beginning of the *Spring*, and before *Herbs* shoot forth into *Flowers*. This, (as we suppose) may very well be, in regard the *Heifers* about the beginning of the *Spring*, feed upon *Thyme* and *Cassia*, which soon after shooting forth into *Flowers*, contain little *Eggs*, which being agitated by heat and the subtil matter, are dilated, and at length are delivered of these little *Animals*. For what the common belief is of most men, is absolutely false, namely, that *Bees* are generated out of the corrupted *Carcases* of *Oxen*. However this seems more likely than that *exterior Causes* should be able to meet so opportunely, as to build or frame *Organs* of *Animals*, such as whose *fabrick* or *structure* can be comprehended by no human understanding unless perhaps some *Seminary* and *Plastick Virtue* lie hid in the said *Bodies*, which being scarce credible, it seems a much greater probability, that all *Generation* is univocal, and that almost all *Animals* are procreated by others of the same kind.

And much after the same we may determin concerning *Animals* discovered in *water*, wherein *Pepper* hath for the space of three days been infused. For altho' they are too minute to be well discerned by our *Senses*, yet they are fram'd with so great and almost infinite variety of *Organs*, that they must needs be allowed to be the progeny of others of that kind, and most likely it is that their *Eggs* have lain hid in the *Pepper*.

VII.
Locusts breed of the Seed of Flies.

VIII.
Bees generated out of Heifers.

IX.
Animals discovered in a mixture of Pepper and Water.

Worms

X.
Worms bred
in Fruits.

Worms are generated in Fruits; and Flies which are so numerous in Summer, cannot be produc'd by any act of Generation, since the whole race of Flies being destroyed, there can be none surviving to produce others.

Worms are bred within the Pulps of Fruits, not spontaneously, as if there were nothing in the Fruit before, from whence they may be generated, but from a premised Seed, that is to say, while Bees or Flies, sitting upon Flowers, leave behind them certain little Eggs, which being intercepted within the Fruits, are disclosed by the urging heat, and turn into Worms. Thus Fruits and Herbs breed Worms, when they are exposed to the Air; and sometimes in one and the same Plant, divers sorts of Insects are to be seen: But if any Plant be inclosed within a Vessel, and the said Vessel be kept close stop'd, so that the Air can have no access, no Worms will there breed from any putrefaction; nor is Cheese capable of breeding Mites, if kept in a Glass Vial well stop'd and Hermetically sealed.

XI.
Flies are
generated
of other
Flies.

So Flies are not bred spontaneously, but by a premised copulation, and of Eggs laid, which being promiscuously dispers'd in the Earth, and afterwards cherish'd by vernal heat, are deliver'd of the respective Animal: For if PLINY may be credited, Flies, as also Ants, Beetles, Bees, Spiders, Wasps, and other such like Animals generate by commixture or copulation; and this is chiefly to be prov'd by this one Argument, namely, because some years, Flies, Locusts, &c. are more abundant than others, make greater waste and havoc in the Fields, and more infest Mankind, which certainly can be from no other cause, but for that in a mild Winter they were preserv'd and not destroyed by the coldness or moisture of the Earth.

XII.
How Worms
breed in the
Maws of
Infants.

Wherefore by no means can we assent to those Peripatetick Physicians, who affirm that Maw-worms are bred in the Intestines out of putrefaction, by the means of Heat; as in like manner they assert of other Insects, that by the heat of the Sun they are produc'd out of Horses, Cows or other Animals Dung. But it may more probably be alledged, that the Maw-worms have their production from the little Eggs of Insects swallowed down by Children with their Meat. For our Meat cannot be so exactly preserved, but that it may by some way or other be contaminated by invisible Insects, which continually fly up and down in the Air. And whereas the meats swarming with those Eggs, are conveyed into the stomach; the said Eggs by this means remain entire, and being cherish'd by a gentle heat, are at length delivered of these Worms: And for a clear demonstration hereof it is to be observed, that Children during the time they suck, are never troubled with Worms, nor are they in the least subject to this Distemper, till they come to feed upon more solid meat; whereas before they immediately drew their nutriment from the Breasts, in which none of these little Eggs could harbour. But when they come to feed upon external nutriments, they are then more exposed to the breeding of Worms, because the fermentations in those nutriments are not powerful enough to destroy the Eggs.

XIII.
That some
Flies are
viviparous

ALDROVANDUS in his first Book of Insects affirms, that some Flies are viviparous or

capable of bringing forth living Flies: I took, saith he, when I was young, being entic'd by the specious form thereof, one of the bigger sort of Flies, streakt with several white Lines; which when I had kept some time in the hollow of my hand, I perceived at last proceeding from it, certain small white Worms crawling up and down. And tho' he speaks but of his catching one only Fly, which had Worms living and moving within her womb, yet it may easily be imagin'd, and inferred that the rest of that kind are also viviparous.

Some Animals become pregnant by the wind, as PLINY relates of Mares in Spain and Capadocia, in his Eighth Book, Chap. 42. It is certain, saith he, that in Portugal on the Banks of the River Tagus, near Lisbon, there are certain Mares, which turning their Face to the West-wind, when it blows, conceive thereby an Animal Spirit, which proceeds to a Birth, that is brought forth into the world with wonderful ease and expedition, but retains not life beyond the term of three years. This the Ancients gave credit to, but I fear, not upon so exact examination and enquiry, as a matter of this nature requires; since sure enough it is that Generation cannot be effected without the coition of Male and Female, unless perhaps that which they call Hippomanes, be taken for a Birth, that I say, which Mares, while they are exposed to the wind, emit. I have ask'd some Portugueses whether or no it were true which some Ancient Authors have delivered concerning the fruitfulness of the Portugal Mares, and whether any sort of Wind was so efficacious as to deserve to be termed a Father of Living Creatures. Of these persons, some profess'd themselves totally ignorant of the matter; others, whom the reading of Ancient Authors had incited to a more narrow search and enquiry into Antiquity said, that they had heard indeed that Mares sometimes bring forth certain misshapen and formless Masses, or lumps of Flesh, having nothing of resemblance with the shape of a Horse, or any other Animal: But this happens very rarely, and that too, only when they are high fed, and raging with desire of Copulation, are kept from the company of the Male. Whence we cannot but admire that PLINY, COLUMELLA, and other Accurate Writers of Natural Causes, should make mention of this strange sort of Geniture, which neither they themselves had observed, nor could warrant the truth thereof to the World by any sufficient Testimonies; except we compare this opinion of theirs concerning the fruitfulness of those Mares, and their celerity of Birth, with some conceits of Justine the Epitomizer.

Nor is it with less uncertainty, that AELIAN in his 2d Book of Animals, asserts the Conception of Vulturs by the Wind, and their exposing their hinder part to the North-wind, to be as it were trodden and impregnated by the said Wind, since among Vulturs there is known to be a Male and Female, by the conjunction whereof Generation is produc'd, according to the common direction of Nature. Moreover, their Neasts are discovered, and they are known to couple at set times of the year. Nor signifies it any thing to say, that some Animals lay Eggs, which from the Wind are called Hypenemious or Subventaneous, that is to say, indeed Wind-trodden Eggs, as Hens, Partridges, &c.

XIV.
Whether
Mares may
be impreg-
nated by
the Wind.

XV.
Vulturs
falsely given
out to con-
ceive by the
Wind.

CHAP. II.

Of Animals produc'd of Seed.

SOME Animals are thought to be of one Sex only, and to Generate and bring forth without the Male, as ARISTOTLE in the 11th Chapter of the 4th Book of his *Natural History*, relates of *Roebets* and *Plaice* among *Fishes*; which when they are taken, are found to have Eggs. The same thing is affirmed of *Oysters*, and some other *Shell-fish*, that they are impregnated with their own proper Seed, and that they breed and bring forth their like without Natural Coition.

Those that stand up for Aristotle and right or wrong defend whatsoever hath been wrought by him, admit, without the least difficulty, this assertion of his, because he Judges so, Writes so, and will have it so: But we who prefer Truth before Aristotle, and think nothing fit to be received which is not consentaneous to Reason and Experience, reject his Assertion as *Fabulous*, as having conferred with Men of undoubted Credit and Reputation, who affirm that they have seen *Roebets* without Spawn, and *Plaice*, *Male* and *Female*, in conjunction together. And indeed it is utterly repugnant to Reason, that any *Animal* should procreate by it self, and propagate its *Species* without the help of another. So that I am apt to believe that Aristotle delivered not this to be his Sentiment, as totally relying upon his own proper Judgment or Experience, but rather by suffering himself to be led aside by the Credit of those *Fishermen* whom he had hired to discover to him the Nature and Properties of *Fish*. The same may be said of *Oysters* and such like *Shell-fish*; since there are many who affirm that they have seen *Horn-fish* and *Purples* in *Conjunction* each with their kind: Nay, and that they have observed their *Meeting* at set times of the year to perform the said work of *Generation*.

Women that are maimed or deprived of one or more Limbs, sometimes bring forth Children affected with the like *Mutilation*, as that *Woman* mentioned by GASSENDUS, who having formerly brought forth many Children perfect and intire, afterwards when she had lost one of her Fingers, brought forth several Children, in like manner, deficient. Sir KENELM DIGBY gives us a Relation of a certain *Woman* whom he saw in *Barbary*, who having two *Thumbs* on her Left Hand, was attended by four Daughters, whom she brought forth thumb'd in like manner.

Ancient Physicians generally alledge one main cause of these and the like effects, namely the deflux of the Seed from all parts of the Body: Forasmuch as since the Blood is carried by a perpetual motion through the Body of the Animal, it is not to be doubted but that the subtil part thereof adapted to Generation, by passing through all its parts, is concocted by every one of them, and affected in a certain peculiar manner, so that it partakes of the qualities of each, and carries them along with it to the Heart, whereunto it tends; and where it is separated from another more gross part, and laid up in receptacles appointed by Nature. And this, say they, is the Seed which every Animal makes use of for the Generation of others like

I.
Whether
Whitings
and such
like Fishes
are of one
Sex only.

II.
That Chil-
dren some-
times inhe-
rit the de-
fects of
their Pa-
rents.

which before such time as they have experienc'd Coition, emit those *subventaneous Births*: Since these sorts of Eggs are barren, smaller and more liquid than those, which being produc'd by Copulation, are capable of fecundity. Nor can the liquor of them by any brooding of the Hen be brought to thicken, but still remains what it was at first.

XVI. In the *Braß Furnaces* in the *Isle of Cyprus*, where the *Stone Chalcites* being cast in, is many days a burning, there spring up on a sudden in the very midst of the Fire, certain little winged Animals, called *Pyraustæ*, somewhat bigger than great Flies; which nimbly run and frisk up and down in the fire. ARISTOTLE makes mention of them in the 5th Book of his *History of Animals*, Chap. 19.

These *Pyraustæ* breed not of the simple substance of the fire, but out of Eggs left by this kind of Animal in the *Stone Chalcites*; for I cannot but persuade my self, that this *Chalcites* in the Mines is condens'd out of a certain Juice, from which, as from a kind of Vehicle, certain Eggs, apt for the generating of these *Pyraustæ*, proceed out of some Vegetable Body; so that in line the *Pyraustæ* themselves are procreated out of these Eggs, the fat humour being mixt to the Metallic Matter, and thereupon live unburnt in the fire. In regard such is the temper of the Matter whereof they consist as long to endure the fire, and like *Adiantum* to elude the strength of the flames. St. AUGUSTIN in the 21st Book of his *Teatise De Civitate Dei*, mentions also a sort of Worms found in bubbling Streams of Water, so hot, as not to be touch'd without scalding.

XVII. TORNIELLUS in his Book of the World, takes notice of a light kind of Wood, and to all outward appearance combustible, said to be brought from the Mountains of Java, whereof a small portion hath been cut off with a Knife, and cast into a large Coal Fire, and not been consumed, nay, not so much as lighted, impaired or diminished; but being taken out, hath appeared as if it had never been cast into the fire.

XVIII. And altho' the same thing be vulgarly reported of the Salamander, yet I dare not maintain it as a compleat truth, since most certain it is, that at Rome a Salamander being cast into the fire by Corrinii, a Roman Knight, immediately swell'd, and sent forth a fat thick matter which quench'd the Coals, and by repeated vomitings endeavour'd to defend himself from the cruel Ardours of the fire.

XIX. LEMNIUS saw, as himself attests, Mantles Knit or Woven of a certain incombustible sort of Flax which yield not to the fire, and are invincible to the hottest flames; insomuch that if at any time these Clothes come to be sullied, or contract any thing of Soil or Spots, there is no need of Soap or Lie for the taking out of these Spots, but the Garments are thrown whole into a great fire, and immediately become all in a blaze as if bedawb'd with Grease; but being taken out, they are fresh, and cleansed of all their Spots. The same sort of Plant is said to grow in the Desert and Sandy Parts of India, whereof some Stocks, acquire from the condition of the Soil, and quality of the Ambient Air, such disposition as to be capable of being woven into Linnen.

XVI.
The Pyraustæ
breed
in flames of
fire.

XVII.
A certain
sort of Wood
incombustible.

XVIII.
The vulgar
opinion of
the Salamander.

XIX.
Some sort
of Linnen
which no
fire consumes.

like it self. So that if it chance that the *Animal* from which that *Spermatick Matter* is drawn, wants any *Limb* or *Member*, no *virtue* of the said *Member* will be in the *Blood*, and consequently the *Birth* will come forth *maimed*, or destitute of some part or parts. Or if any part or parts in the *Animal* exceed, as Sir *Kenelm* relates of the *African Woman*, or there be any exuberance or excrescence of *Flesh*, the same deformity will be also concomitant to the *Birth*, unless this redundancy be temper'd by the *Seed* of the other *Parent*, or the superfluity of the *Blood* be corrected.

III.
Defects,
Diseases
and Vices
of Parents
entail'd
upon their
Children.

And for the same cause they say it is, that they who are troubled with the *Gout*, *Epilepsie*, *Leprosie*, or any such like contagious *disease*, impart the same to their *Births*: Especially the *Mothers*, since they afford them *Aliment*, and together with the *Blood*, the habit of *Body*, as they likewise communicate the *manners* and *dispositions* of the *Mind*. Hence commonly it falls out that *lewd* and *drunken Women* bring forth *Children* of the same temper and like themselves entailing their *vices* on their *Offspring*.

IV.
How Chil-
dren come
to be mark'd
with their
Parents
defects.

But as in *Fruits* it may possibly be conjectur'd, that the *Buds* and *Efflorescences* have been form'd in their original exemplar from the beginning of the *world*; so the like is to be inferr'd in the production of all *Animals*; and tho' it may seem very difficult to comprehend how the *form* and *features* of *Parents* are imprinted in the *Births*; yet if we seriously consider it, we shall find it not so hard a matter to conceive as we think, that the *figure* of a *Body* so small, and so flexible as is that of an *Embryo*, may be diversly modified, whether it be by the *Bodies* which serve to extend and enlarge it, or by those which close or compress it, or by the *imagination* of the *Mother* which hath power to remove the *humours*, and consequently to cause them to flow towards some parts rather than others. For when they fail to bend their motion towards some parts of the *Infant*, then it is that the *Infant* is born with the Defects of the *maimed Parent*.

V.
How Exu-
berances or
Additions
of Parts
happen.

And on the contrary, if it happen that they have exuberances or more parts than belong to a compleat *Birth*, as two *Heads*, or the like; this addition of *parts* may be attributed to the meeting of two *Eggs* hitting together, or whose parts have been disordered, intermingled, or crush'd together through the motion of the *Humours*, several ways, by the *imagination* of the *Mother*.

VI.
The Cause
of Womens
Barrenness.

Some *Women* are undoubtedly *barren* and incapable of ever bringing forth *Children*, and the reason is evident from things already discours'd of in our *Institution* of *Philosophy*; namely, that every *Egg*, in its proper receptacle, that is, the *Womens Testicles* is render'd fruitful by the *Virile Contact*, that the *Egg* thus fecundated or fructified, increases daily more and more, and is at length shut up in the *Womb*, and is there, as it were, ripened with *heat*, till such time as it hath received all its *Lineaments*. So that *Women* are *Barren* when their *Eggs* are either intemperate, or hardened, or wrapt in a *Membran* too thick to be fermented by the touch of the *Virile* or *Male Seed*; or because their *Eggs* are too small or juiceless, so as to contain little or nothing in them, or else because their whole *Bodies* are intemperate or full of gross

humours, or are over fat, or because they are troubled with the *Whites*, or have their *Courses* too much. But of all others, the chief cause of Sterility is said to consist in the obstruction of the *Fallopian Tubes*, since if this chance to be obstructed, the *Seminal Spirit* cannot reach the *Ovary* to fructify it.

Women, whom the Monthly benefit of Nature fails, are *barren* and void of all fecundity.

The Reason is, because at such a time the *Vessels* being obstructed, the passage is render'd incapable to transmit the Genital Air to the *Ovaryum*. Whereas *Women*, when their *Courses* begin, and more especially when newly over, are sooner impregnated and conceive, because the *Womb* is moist with a certain roscid *humour*, and more easily attracts and retains the *Seed*.

Women have not their *Courses* at the same time in all *Countries*. In very hot *Climats*, for the most part, the *Profluvium* begins in the 7th or 8th year: So the story goes of an *Indian Girl*, who was married at seven years old, and at eight brought forth a *Boy*. In temperate Regions at 12 or 14; in cold Regions seldom before the 16th or 18th year of Age: In persons very young these *Fluors* break not out, both in regard the *Blood* is for the most part taken up in the nutrition of the *Body*, as also because the *Blood* is not sharp enough to open easily the *Mouths* of the *Vessels*: In *Women* growing into years it ceases, in regard the *Blood* thickning for want of due fermentation, is not so fluid as in the strong and youthful.

She *Mules* are generally accounted barren and incapable to bring forth their like.

The Cause of this sterility in *Mules*, Modern *Physicians* attribute to the want of *Eggs* in the *Womb*. For *STENO*, who first discovered and made publick the *Ovary* in *Women*, affirms that *Mules* have indeed *Testicles*, but are destitute of *Eggs*, and therefore no wonder they are so barren, since they have not like other *Animals*, *Eggs* in those *Testicles*.

However some there are that question this Tradition, and assert that the *Mules* are not altogether barren, since there have been *Mules* known which have brought forth; particularly there was one of late in *Auvergn* that brought forth a young *Mule*. And *PLINY* quotes *Theophrastus* his Testimony, that *Mules* in *Cappadocia* bring forth not only those that are generated of a *He Ass* and *Mare*, but also such as are begot of *Mares*, and wild *Asses*, tho' this seldom happens by reason of the great difference of parts which constitute the *Womb* of a *He Ass*, and those which constitute that of a *Mare*; forasmuch as the *Asinine Birth* possesses those *Caruncles*, *Placents* and *Zones* which the *Equine Birth* is destitute of. Wherefore it must needs be, that whereas a *She Mule* partakes not of all those parts, she cannot but be barren, unless some extraordinary accident happen.

Overmuch effusion of *Seed* is very hurtful to the *Brain* and *Nerves*, and creates an extraordinary weakness in them, as those persons by experience find, that too much indulge to *Venery*.

HIPPOCRATES was of opinion, and to this day it is the belief of many *Physicians*, that the *Genital Humour* is derived from the *Brain* into the *Spermatick Vessels*, whereof when-ever there is any evacuation made, the *Brain* must of necessity

VII.
Women de-
prived of
the usual
benefit of
Nature, are
barren.

VIII.
When the
Menstruous
Flux be-
gins in
Woman.

IX.
Whether
She Mules
are barren,
and for
what cause.

XI.
A too fre-
quent effu-
sion of Seed
hurtful to
the Brain.

necessity be weakened. But since there appears no peculiar Channels from the *Brain*, which can convey the forefaid *humour* to the *Spermatick Parts*, it is most consentaneous to reason, that this noble *humour* is generated out of the *maß* of *Blood*, or as others will have, out of the *Nutritious Juice* and *Animal Spirit* well compounded, whereof some part is no less diffused to the *Genitals* than to the *Brain*. But that the overmuch waftings of the *Genital Humour* should endamage and weaken the *Brain*, that arises from hence, namely because the *Blood* to repair the *spent Seed*, puts the *Brain* to the expence of its most subtil part to supply the *Spermatick Vessels* with a sufficient quantity of *Animal Spirits*. Nay, when the *Blood* out of its own substance cannot contribute sufficiently to the *Genitals*, it claims of the *Brain* a Grant of new matter formerly borrowed on purpose.

XI. *Children* most commonly are like to one or other of their *Progenitors*, and sometimes resemble both. Some *Women* have the resemblance of the *Grand Father*, *Great Grand Father*, or some other of their *Ancestors*. As that *Gracian Woman*, mention'd by *PLINY*, being accused of *Adultery* because she had brought forth a *Black*, was acquitted and judged innocent when it appeared that she was but the fourth degree removed from an *Ethiopian* Ancestry.

It is a common opinion of ancient *Physicians*, that if the *Womans Seed* abound, the *Birth* becomes like the *Mother*; if the *Mans Seed* predominate, it is most like to the *Father*; but if there be an equal proportion on both sides, that then there is a resemblance to each party alike; and to this purpose and almost in the same terms *LAC-TANTIUS* expresses himself.

XII. But I rather think, as I said a little before, comparing the *Germination* of *Plants* with the *Production* of *Animals*, that the resemblance of *Children* to *Parents*, is not caused by the exceeding quantity of *Seed*, either of the one or the other *Parent*, but rather because the *Seed* of the *Male*, making way into the *Pores* of the *Eggs*, opens them in such a manner, that they are more disposed to receive the matter whose *particles* resemble those of the *Male Seed* than to admit of others, by reason whereof the *particles*, which make up the composition of the *Infants Body*, rank themselves in such sort as those are rank'd which compose the *Fathers*; and this is the true cause of *Father* and *Sons* resembling each other. The same reason may be given of *Infants* being born with a resemblance to the *Grand Father*, or any other *Ancestor*, whom neither *Father* nor *Mother* ever knew. For it may easily be conceiv'd, that *Ancestors* may possibly have impress'd in their begotten *Off-spring* such sort of dispositions, that the parts of their *Seed* cause in the *particles* of the *Eggs* those particular structures which are proper to produce in the *Birth* a *Figure* modified rather one way than another.

XIII. But some will say, if *Infants* are thus inclosed, and as if it were fenc'd about in *Eggs*, how comes it that some are born *Lame*, others *Gibbous* or bunch backt?

This happens when the *Infant* is so streightned in the *Womb*, that all the parts cannot grow proportionably; whether it be that the *Womb* is too little, or because the parts of the *Birth* are

diversly affected by some exteriour cause. For by this means the *Infant* must needs be out of order, that is, must have some *Member* greater or smaller, or otherwise dispos'd than the natural construction of the *Body* requires.

Hence it is that wise men oft beget *Changelings*, or *Children* of little or no *understanding*: Because having their *minds* employed in subtil inventions, or some serious points of *Learning* or *Art*, they little mind the *Sports* of *Venus*, and are very slack and indifferent in the performances thereof. On the contrary, those that are eagerly bent upon the *Act* of *Generation*, for the most part beget *Children* of like *Affections*, *Manners*, *Studies* and *Inclinations* of *Mind*. For those *Children* in whom vigour of *Soul* and *Vital Spirit* is infused from the faculty of the *Seed*, cannot but be of the same *Disposition*, *Nature* and *Temperament* with their *Progenitors*.

The *Matrons* of *Holland* by looking earnestly upon a *Hare*, oft-times bring forth *Children* with the Upper-Lip divided, or as we commonly call them *Hare-Lipt*. In like manner, some have *Flat Noses*, *Wry Mouths*, *Blubber Lips*, and a habit of *Body*, all over deformed.

The Reason is, because *Women* in the time of their conception or going with *Child*, have many times their *Eyes*, *Thoughts* and *Fancies* strongly fixt upon some or other misshapen or ill favour'd sight: For such is the force of *Imagination*, that when a *Woman* Looks or Thinks upon any thing very earnestly, she commonly brings forth some thing very nearly resembling the thing so seen or thought on. So a certain *Woman* not forgotten in story, who having cast away all shame, while her *Husband* was absent, and prostituted her self to another person, brought forth a *Child* no way like to the *Gallant*, but the very Picture of her absent *Husband*: The cause whereof is Elegantly and Wittily described by Sir *Thomas More* in one of his *Epigrams*.

The like is related by *GALEN*, namely, that a certain *Woman* brought forth a *Child* not at all like the *Father*, who was naturally deformed in *Body*, and of an ill-favour'd Visage, but to a fair *Image* or *Picture* which her *Husband* had often desired her frequently to cast her *Eyes* upon. And *PORTÆUS* makes relation of another *Woman*, who delighting as it were by a natural propensity, to have frequently in her sight, and oftener in her mind a *Statue* of *Marble* representing a *Fat Boy*, brought forth a kind of *Man Child* Pale and Wan, and indeed wholly resembling the said *Statue*. Nor is this peculiar only to *Human Race*, but common also to *Brute Animals*, of which more in the following Chapter.

Whence it is that *Twins* are brought forth at one *Birth*.

Ancient *Physicians* were of opinion, that the *Womb* is distinguisht into so many *Cavities* or *Cells*, divided by *Membrans* from one another as there are *Births* generated in the *Womb*; but the contrary is proved by experience. For the *Womb* hath in reality but one continued *Cavity*; and the truth of the matter is this, when several *Births*, at one time are generated in the *Womb*, they are contain'd each in their proper *Membrans*; so that if two, three or more *Births* are conceived, it is when the *Male Seed* hath been very spirituous, even to the im-

XIV. How it comes to pass that sometimes Wifely Men beget Fools.

XV. Whence it is that the Women of Holland bring forth Harelip Children.

XVI. Whence it is that Children are brought forth like to the things it held.

XVII. How Twins are generated.

XIII. Whence it is that some Children are born Lame, or others Gibbous.

impregnation of so many Eggs, with the same fruitfulness through the Fallopian Tubes, as if there were but one, which being driven down to the bottom of the Womb, are there each of them fructified.

XVIII.
Whether
Issues dis-
pose to Bar-
renness.

It is a *Vulgar Maxim* among *Women*, and by some taken for a certain truth, especially here in *England*, that if a *Woman* have but one Issue, she is condemned to Sterility or Barrenness, and much more, if more. Therefore to married *Women* that are in expectation of *Childing*, this sort of application, tho' otherwise thought very conducive to health, is most strictly forbidden.

But of this Interdiction I have yet found no just reason alledged, only there are cited some stories of *Barren Women* with *Issues* about them; but it would not be difficult to produce relations of very many *Barren Women* without *Issues*, and of many *Fruitful ones* which have them.

CHAP. III.

Of Monsters.

I.
What a
Monster is.

THOSE we call *Monsters* are Natural Births, or Natural Living Creatures degenerating from the due and wonted disposition of their Species. Now they are said to degenerate if there happen any superfluous Member, or any necessary one be wanting, or any part be in a wrong place, or be of another kind than what it ought to be; so that those persons are said to be *Monstrous* who are either born without Arms, or with more than ought to be, or have them in a wrong place, as in the Thighs, or have the Head of a Ram, or other unhuman Creature, not to mention several other accidents of this nature.

II.
Of a Two-
headed
Twin Fac'd
and double-
breasted
Birth.

There goes a tradition of a Boy, born in the Reign of the Emperor Theodosius at Emaus, who from the Navil downward was perfect as others of his kind, but upwards was all double; Head, Face and Breast, had the use of his Senses, and of all his double parts by turns, while one eat and drank the other abstained, and with the like vicissitude while one slept, the other waked; while one sported, the other was serious; discovering hereby effects of a different Mind and Temper, and in this manner he lived near two years.

III.
A Child
born with-
out a Head.
Another
without
Feet, others
without
Hands or
Feet.

In 1504, in *Misnia*, a Child was born without a Head, his Eyes being placed in his Breast. Another in *Nebruz*, not far from the City *Wurz* was born without Feet. Others the *Roman History* mentions born without Hands and Feet.

IV.
A Monster
with one
Arm in the
Ear, and
another in
the Side.

In *Stetin* was born a Monster shaped as followeth, in the place of the Head there was an unformed Mass or Lump, rising and sinking like a Sheep's Intrals; in the place of one Ear stood out an Arm, where the Face should be, there was a tuft of Hair like a Cat's Fur, and the Spawn of a Pike Fish, through the lower part whereof the Eyes cast a splendor like Glasse; the Mouth was contracted into a little hole, without Lips; there was something like a Nose, but wonderfully small; nor was there any appearance of a Neck: Another Arm stuck out from one side, but there was no sign either of Back or Breast, excepting that a little small Line seemed to supply the place of the Backbone; it was neither *Hermaphrodite*, nor of any Sex. There was also in the year 1516. another strange Creature born, which lived to be a Man

having no other Head but what grew out from the Navil, yet it took in nourishment as freely as if it had been in its proper place.

In 1560. there was born at *Basil* a Man-child with a fierce and grim Visage, having indeed an indifferent well compacted Body, but Head and Face all hairy, and more resembling that of a Dog, Cat or Ape, than of a Human Creature. He liv'd no longer than about an hour and a half. Near *Lauffenburg*, a Town in *Germany*, on the Borders of *Switzerland*, a Child was born with a rough and frightful Head, and the Feet of a Goose.

Of all these strange Births various causes may be assigned: For in the first place, we may without offence believe that the first Seed-plot of Monsters as well as of perfect Creatures, was planted in the beginning, and that Generation only conduces to render them capable of a sensible growth; nor doth it avail to say, that GOD cannot be the Author of Monsters, for he would be so nevertheless, tho' the first Seed-plot of Monsters were not till after the beginning; and there is a ready answer, viz. That there is nothing in the World except Immorality, of which GOD is not the Author.

2dly, The cause of any Monstrous defect is either in the Conception, or the Egg, in which some passages are by accident obstructed, or some Fibres pluckt off; or in the Womb, when the Placenta, into which the Male Stock is ingrafted, hath suffered any defect; or in the decision of the Conception, or last efflorescence.

3dly, These Monstrous Bodies may possibly proceed from the straightness of the Womb, whence HIPPOCRATES compares an over-straight Womb to a stony place, which causes the Tree that springs up there, to become bent or dismembred; or to the narrow Neck of a Vessel which stifles the growth of the Cucumber when tender, and contracts and curtails it when growing to maturity.

4ly, The force of Imagination may produce a defect, or exorbitancy in the Birth, as we oft see Warts and Spots impress'd upon the Birth by Imagination; and these Spots are not always the simple resemblances of Cherries, Mulberries, but also sometimes of Entrails, as Liver, Heart, &c. Now if this Imagination have such a power upon one part, why may it not have the like upon many, nay upon all?

Animals which bear Twins, sometimes bring forth Monstrous Births. So we see may times out of one and the same Egg, a double Monster produc'd, a Chicken with four Wings and as many Feet, and sometimes with two Heads. Twins oftentimes are born with their two Bodies joined together into one; as at *Constance*, near a place called *Abroonium*, there were born two Children, Male and Female, with two Heads, four Arms, and as many Feet, that is, each of them had all their Members compleat, only they were joined together about the Navil.

The Reason seems to be, because altho' Twins in most Animals are wrapt up in the same Membran, called *Chorion*, yet each of the Births hath its proper Membran, called *Amnion*, and therein a separate Conception; yet sometimes it happens that these two Membrans, mix as it were into one, or at last mutually intersect each other, whence certainly arises a great confusion of parts, for this

V.
A Monster
born with
the Head of
a Dog or
Ape.

VI.
There might
possibly be a
foundation
of Monsters
from the
beginning.

VII.
Or some
Cause may
be in the
Conception.

VIII.
Or from the
straightness
of the
Womb.

IX.
Or from the
Imagination.

X.
How Twins
come to be
born with
Bodies join-
ed or fast-
ened to each
other.

the *Fibres* and the *Canals* have proper to themselves, viz. that they easily join into a Contexture; so there is not a total confution of the Colliquaments, but only some commixture and compression which will cause the two *Twins*, thus united together; to have some parts in common; and the Colliquament, upon the consumption of one of the salient points, to turn into a duplicated *Animal*, and consequently some *Members* will prove superfluous. The same thing happens in *Fruits*, if they be crowded up in straight places before they arrive to their due magnitude, as hath been already hinted, tho' *Plants* seldom undergo this sort of failures and lapses of *Nature*, because they are more plain and simple, and the *Organs* of their *Body* are lesser and less exact; so that in their constitution they give *Generating Nature* less occasion to err. For it is very obvious to err in composing works of divers parts join'd each to other with most curious Artifice, as the *Members* of *Animals* are. Whence it appears, that *Mother* consult very ill for themselves and *Children*, while they live idly and lazily at home, and incommode the *Child* within them, while they sit double or cross-leg'd at their *Needle-work*. Forasmuch as by this overmuch contraction, they bring *Children* into the *World* Bunch-Backt, Splay-Footed, Crooked or Awry, or some way or other Mismatched.

XI.
How Africa comes chiefly to abound in Monsters.

Sometimes also *Monsters* are produc'd from the various commixture of divers *Seeds*, that is, when the sorts of *Seeds* are taken in at several times one before, another after. Hence it is that *Africa* is generally said to abound in *Monsters*, because *Animals* of different kind resort from all parts of the *Country* to drink of what *Streams* of *Fresh Water* they can find, which are fewer than in any other quarter of the *World*; and so rencountering each other, they couple promiscuously together, and bring forth productions never intended by *Nature*.

XII.
How it may be known whether Monsters, having double parts, be two Animals, or but one.

The next thing to be considered is, whether *Monsters* that have double parts, can be said to be two *Animals* or one. To determine this the better, it is to be supposed, that the *Heart* is the principal part of every *Animal*; forasmuch as all other parts derive their original from it; so that if there be two *Hearts* in any *Animal*, it will necessarily follow that the *Animal* possessing those two *Hearts* is a double *Animal*. For as it is the principle of the *Operations* of the *sensitive Soul*, according to the *Internal Senses*, and in part according to the motions of the *Appetite*; so it is vulgarly said to be the principle of the *Vegetative* and *sensitive Soul*, according to the motions of the *Appetite*. Hereupon SENNERTUS infers, that that *Monstrous Birth* of *Eman* having two *Heads* and two *Hearts*, was to be accounted two *Men*: But that the other born in the year 1531, who had two *Heads*, and but only one *Heart* and lived to *Mans Estate*, was to be reckoned no more than but one *Man*, which he proved by this Argument viz. that the two *Heads* perpetually testified their consent to the same actions, had the same appetite, the same hunger and thirst, spake in the same manner, had the same desire to accompany with their *Wife*, the same desire to exonerate *Nature*. But in the other who had two *Hearts*, there was not found the same conspiracy and consent of *Affections* and *desires*; what this would have at one time, the other affected at

another time; sometimes they agreed, sometimes they squabbed.

Monstrous Births proceed not only from *Man-kind*, but also from other *Animals*; forasmuch as being equally endued with *Corporeal Imagination*, they may be as eagerly intent in the beholding of any *Object*, and by this means may induce various *Forms* upon their *Births*. So *Jacob* made a great part of his *Uncle Labans Flock* his own, by the ringstreaked and variously spotted *Rods* he cast before the *Ews* when they were ready to conceive: Thus we draw fine *Pictures* upon the *Wings* and *Tails* of divers sorts of *Birds*; thus we produce delicate breeds of *Dogs* and *Horses* curiously streakt and spotted; and who knows but that that wonderfully shapt *Monster* described by FINCELIUS might be produced by this or some such like artifice; that *Monster*, I say, which being calv'd by a *Cow*, had the Feet of a *Calf*, a *Mans Head*, with both Ears also like a *Man*, and Hair of an indifferent length, a *Breast* also and *Teats* on them like a *Human Creature*. Nor must the *Turkey Hen* be past by, which had the *Body* of a *Peacock*, the *Crest* and *Dewlap* of a *Game Cock*, a *Voice* like that of the *Peacock*, and a noble display of Colours on the *Tail*; for such is the force and power of the imaginary, tho' corporeal *Faculty*, that when *Animals* behold any thing attentively, it makes so deep an impression in them, that they impart those impressions of various forms upon their *Births*.

XIII.
Monstrous Births in other Animals besides Mankind.

But there are more differences and varieties in *Man* than in other *Creatures*, by reason that swiftness of *Thought*, readiness of *Mind* and variety of *Fancy* and *Ingenuity* makes impressions of various forms, whereas other *Creatures*, have for the most part the same reception of *Images* which are produc'd from the variety of *Tracts* impresst in the *Brain*, whereby it comes to pass, that a *Womans Imagination* induces a strange and borrowed *Form* and *Image*, no way like to the begetter, but totally differing from them.

Now upon serious reflection of all that hath been said on this *Subject*, there is nothing more odious and detestable to me, than to see wanton *Women* so excessively delight themselves with *Dogs* and *Apes*, as to carry them in their *Bosoms*, hug them, stroak them, and be continually handling and making much of them; since by this familiarity, and having these *Creatures* perpetually in their sight, the imperfect *Nature* of *Women* is apt to conceive in the *Mind* one or other strange form or feature, and so fix upon the *Birth* a *Face* like some of those *Animals* they converse with, or at least some way or other specially illfavoured. Yea, sometimes *Children* are brought into the *world* with odd kind of shap'd *Bodies*, Visages out of the common road of *Human Aspect*, distorted *Mouths* and *Cheeks*, inflate like the *Picture* of the *Northwind*, and all by the *Mother*s regards continually and intently fixt upon brutal and unwonted *Objects*.

XIV.
But most in Mankind.

XV.
Whence the deformity of some Bodies.

CHAP. IV.

Of the Birth of Animals.

I. Why Women bring forth but one Child at a Birth.

Women lie in commonly but of one Child, whereas other Creatures bring forth many of their kind at a Birth.

This is, because in those Animals there are divers Cells or Fleſhy Eminences, to which ſmall Eggs are faſtned, one to each: But it is not ſo with Women, for tho' the Virile Seed aſcends in vapors to the Teſticles through the Tubes of the Matrice; yet notwithſtanding Women do not commonly conceive two Children, by reaſon that the Womb hath but one Cavity; and that for the accompliſhing of Generation, it is not enough that it be receiv'd into Teſticles, but it muſt alſo be received into the pores of the Eggs to cauſe them to ferment; nor can theſe pores receive it till after the Egg is brought to a certain point of maturity, to which commonly, in Women, they attain not to, but only one after another; as we ſee in the Ovaries of Hens, whence the Eggs for the moſt part are not unfaſtned but ſucceſſively. We muſt therefore ſuppoſe that when Women bring forth two Children at once, it either proceeds from hence, namely that two Eggs fall at one and the ſame time into the Womb, and that there are two places for them to be faſtned to, and for that the two Eggs have been in ſuch ſort formed in the firſt Creation as to be apt to faſten to the ſame Placenta.

II. Whether there be any ſign to diſcover whether a Woman ſhall have Twins or not.

There are ſome who brag that by a certain ſign or mark, they can eaſily gueſs whether a Big-bellied Woman ſhall have Twins or not.

But their boaſt is vain and groundleſs, for of this matter there can be no certainty, rule or knowledge. It can neither be the big ſwelling of the Belly, which ſometimes is greater in the bearing of a ſingle Birth, than in that of Twins; nor the diverſity of motions, which many times ſome have taken ſuch ſtrict obſervation of from an abortive Embrio only, eſpecially by the ſlow motion thereof, as to believe that the Woman would certainly have had Twins, had ſhe gone out her time. Nor an external Line dividing the Womb in the middle, which ſeveral Anatomists have, even from their own Wives, found experimentally to be a vain conceit: Nor the ſwelling of their Legs and Feet in the laſt Month, or Months of their going with Child, ſince they ſwell in that manner, even in the bearing of ſingle Births: Nor laſtly, the large diſtention of the Belly towards the Sides, which the various ſituation of a ſingle Birth may be the cauſe of. Rebecca indeed from the extraordinary motion of two Embrios ſtrugling one againſt the other, gueſt that ſhe had Twins within her; but this might alſo be partly a Divine Inſtinct.

III. What the Cauſe is of Abortion in Women.

Women oftentimes happen to bring forth an Immature Birth, and to ſuffer an Efflux or Abortion before the due time appointed by Nature for their Delivery. Abortion, or the untimely Excluſion of a Birth, not yet perfected, happens according to the opinion of the Galeniſts, either from the overmuch abundance of Blood, by reaſon of the great afflux thereof to the Womb, more at that time than another; or elſe from the want of Blood in the Mother to nourish the Infant. But in my Judgment there are ſeveral Cauſes to be en-

quired into, as well relating to the Mother, as to the Birth. On the of the Birth, Abortion happens when the Uterine Glands are ſo infirm, that they are ſoon broken; or the Membrans ſo thin, as upon the leaſt occaſion to burſt; upon which the humours breaking forth, the Birth decays. On the part of the Childing Woman, if ſhe be of a weaker Nature than ordinary, and hath not ſtrength ſufficient for the bearing of ſuch a burthen: Sometimes it happens from a ſuddain fright, or the noxious temperament of the Air. To which purpoſe AELIAN relates, that Women inhabiting the Southern Countries are more ſubject to Abortion than thoſe that live more Northerly, becauſe there the Limbs are more ſupple; and thoſe parts which conduce to Childbearing are more looſened.

An Abortion may happen from the firſt moment of Conception to the beginning of the ſeventh Month; but it is moſt frequent about the end of the third: not but there have been examples thereof both before and after that time. Before the tenth Week after Conception, excluſions are ſcarcely taken for a real Abortion, becauſe till after that time ſcarce any rudiment of a Birth appears; ſo that it is then rather accounted for a Mole. For unleſs the Birth appears in the body of the Placenta, it is not allowed to be a true Conception, and conſequently the excluſion thereof cannot be ſaid to be an Abortion.

The end of nine Months is the uſual time of an Infants coming into the world.

The Reaſon of this is, partly becauſe of the overmuch Meconium of the Intestins made by the excrements, which is nothing elſe but the mixture of Phlegm, Choler and Pancreatick Juice, which becauſe of overmuch delay, become overſharp, whence by a troubleſom vellication of the Fibres of the Intestins, it cauſes an influx of the Animal Spirits into all parts, and ſo the Birth overmuch ſtirring it ſelf by its calcitration or kicking, breaks the two Membrans, the Amnion and the Chorion, in which it is wrapr, and gathering it ſelf round, ſhoots downward towards the internal Oriſice of the Womb, which by dilating, it naturally makes its way into the world.

The Viper brings not forth but with the loſs of Life, for on the third day ſhutting in her young ones into her Womb, having about twenty to bring forth, and having brought one a day for two or three days before, the reſt impatient of their ſlow Birth, and haſtning into the Light, bite through the Sides of their Dam, and thereby open a gap to their own Life and her death. Whence Mantuan;

*The Viper wounded by the fatal bite
Of the young Vipers, dies to give them light.*

This Tradition, from the Age of Herodotus to this very time, hath been received for an undoubted Truth, namely, that the Male Viper loſes its Life in the miſt of Copulation, by thruſting its Head into the Mouth of the Female, who through the height of pleaſure bites it off: As alſo that the young ones not tarrying their time, make a ſpeedier way by tearing the Womb, and gnawing through the Breſt of the Dam. But the vanity of this aſſertion they find by experience, who preſerve them in Glaſs Veſſels for their uſe, in certain Medicinal

IV. When Abortive Births uſe to happen.

V. Why Infants are born at nine Months end.

VI. The Viper does not let out her young ones through her diſſected Sides.

Compositions. It may well enough be conjectur'd that this fancy took its original from hence, namely, because *Vipers* are brought forth fenc'd about with their *Membrans*, which in regard some of them break not till the third day after their being brought forth, and others free themselves of them in the *Womb*; hereupon some have taken the *Membran* for the *Womb*, and delivered in writing that the Brood of *Vipers* gnaw through the sides of the *Dam*, and by that corrosion cause her Death.

VII.
But the
Fish *Acus*.

But this is known for a certain, that the Belly of the Fish called *Acus*, in the midst of her breeding, cleaves into a gaping Aperture by reason of the multitude of young ones within her, which cleft is not effected by the corrosion or gnawing of the young Fry, but by the rupture of the Skin making a gap under the bottom of its Belly, by which, contrary to the custom of other Fish, its *Womb* is extended in time of breeding, and in which it lays up its *Spawn*. For RONDELETTIUS upon his own experience attests, that as he was dissecting of one of this sort of Fish, he found abundance of *Spawn* in that very gap; and likewise that as he was inspecting into the said gap, he found in two other lesser ones, some *Spawn* newly hatch'd, and many Births just perfected; whereof some of the biggest moved, but others imperfect, whose Eyes and Mouths were only to be perceived. From all which it may be gathered, that the Fish *Acus* does not so much bring forth young ones, as exclude them out of that bursted Gap, and that the *Viper* suffers no damage by the production of her *Viperous Blood*.

VIII.
How it
comes that
Animals
have each
their set
season of
bringing
forth from
the time of
Copulation.

Animals observe each of them, their certain and determinate time in bringing forth. *Elephants* go 2 Years, *Mares* 11 Months, *Camels* 12 Months, *Cows* 10, *Sheep* 5, *Bitches* 9 Weeks. *Birds* also lay their Eggs at a set time from the Seed received. *Women* also have their ninth or tenth Month for their delivery, which if they exceed, the Birth is accounted either not Natural, or not Legitimate.

There is one common Cause of all these different Seasons, namely, for that the Birth as it grows bigger and bigger, being more and more unsatisfied with its nourishment, makes a stir and eagerly indeavours to enlarge its Commons, and provide it self with a more plentiful subsistence; as also for that being shut up in too narrow a compass, and streightned by the *Membrans* wherein it is wrapt, it shakes the Walls of its Prison to get free. And this is to be observed, not only in *Animals* of the bigger sort, and *viviparous* or live-bearing, but also in the *Oviparous* or Egg-bearing. For a *Chicken* shut up in its Egg, as soon as the Yolk upon which it hath lived is consumed, with the help of its *Dam*, the *Hew*, breaks the *Shell* and gets its liberty. Thus the Egg, after formation compleated, becomes so burdenson to the *Womb*, that being in a sort exasperated, indeavours to expel the said Egg, and to free it self from so troublesome a burthen.

IX.
Why Ani-
mals are
born with
their Head
downward.

All *Creatures*, if they are brought forth according to Nature, are carried inverse, and prone upon the Head, open the Mouth of the *Womb*.

The Reason is, because that part of the Body, from the Navel upwards, to the Head, is more ponderous than that which from the Navel reaches

downward; and since heavy things tend to the lower parts, the Head of the *Infant* must of necessity be carried first to the Orifice of the *Womb*. As of two *Skales* of a *Ballance*, the heavier tends downward, and the other upward. And if at any time it happens otherwise, that Birth is said to be not Natural, but as it were perverting the course of Nature; as when it comes out with its Feet forward, or with one Foot stretcht out, another tending to one side; or when with one or both Hands it offers it self to the Mouth of the *Womb*.

Ancient *Physicians* are of opinion, that a *Septimestrian-Birth*, or a Child born in the seventh Month may live, but that an *Octimestrian* or Eight-month Birth is for the most part fatal.

The Cause hereof HIPPOCRATES attributes to the order of the seven Planets; that preside over Human Affairs, and have their domination or Government over them, each in their turn. So that according to his assertion, the first Month belongs to Saturn, the second to Jupiter, and so of the rest, till the dominion comes to Mercury, who is the lowell of the Planets; which Circuit being finish'd, it returns again to Saturn. But how comes Hippocrates to understand so well this power of the wandring Stars? Wherein is it that this great force of theirs consists? What Instruments guide them to the Infant wrapt up in his *Membrans*? But looking upon these things as the Dreams of a wise or rather industrious Person, I choose to adhere to PLINY, who affirms the contrary to have hapned in Egypt, in which Country he saith, there is nothing more frequent than for *Octimestrian Births* to live, and brings for example, *Cæsonia*, the Wife of the Emperor Caius, who came into World in the eighth Month. This account is confirmed by CARDANUS, bringing an instance of Cardinal Sfondano and others, who being born in the eighth Month, nevertheless lived to a very considerable Age. And what should hinder us from asserting, that Persons born in the eighth Month are more long liv'd than others; since it is a great Argument of vigor that they anticipate the ordinary course of Nature, and as it were take it in dudgeon to be shut up longer in a Prison, unless the blame be laid upon the Mothers weakness, and the Birth be accelerated by an overmuch irritation of the *Womb*.

It is delivered by some Physicians, as well Ancient as Modern, that there are Births of eleven Months: PLINY makes relation in his seventh Book, Chap. 5. of a Woman who was brought to Bed in her thirteenth Month; and AVICEN writes of another that was delivered in her tenth Month.

This Computation may possibly have hapned from the roguery of some Women, and the simplicity of others in misreckning their time. Roguery when a Woman having no Children at her Husbands death, may for enjoyment of his Inheritance, and Personal Estate, accompany with another Person, and have a Child by him within 11, 12, 13, or 14 Months, and so lay the getting of it to her deceased Husband; which kind of Villany is so common, that all the World over in all Judicial Courts ring of it. And this is the reason that these late kind of Births are seldom heard of except in such sort of Widows, but very rarely in

X.
Why In-
fants born
in the 7th
Month live,
and not
those born
in the 8th.

XI.
How In-
fants are
said to be
born in the
12th or
13th
Month.

in those *Women* whose *Husbands* live, and constantly Bed with them. But as to the misreckning, *WVomen* generally compute the beginning of their *Conception* from the first stoppage of their *Courses*, whereas it may possibly fall out, that for some other cause they may stop two or three Months before *Conception*; so that if a *WVoman* begins the computation of her being with *Child*, the very first time of their *Stoppage*, she must needs be in an error, and by reason thereof it will be thought that the *Infant* came into the World on the 11th or 12 Month, when indeed it was born after the wonted manner, at the end of the 9th Month.

XII. A Great *Birth*, when Mature, for the most part kicks, and gathering it self up in a heap, breaks the *Membrans* in which 'tis wrapt.

Why Infants kick a little before their Birth.

This *Kicking* proceeds from a necessity of refreshment or respiration; for the heat of the *Embryo* is small at the beginning, and setting it self at first to shoot out like a small sparkle, it hath then no need of refreshment, but augmentation; but as the bulk encreases by little and little, so also the *Actions* and *Motions* of the *Birth* encrease. But at length the heat is so encreased, that then it chiefly wants ventilation and refrigeration, which not being found, the *Birth* begins by little and little to be more and more disturbed, and by reason of that disturbance and anxiety, to stir and kick at length so much the more strongly, and by that strong motion to incite the *Uterine Vapors* to a violent Effervescence or boiling, and thereby to endeavour to make its passage out into a freer *Air*.

Womens Breasts immediately after their delivery, swell and abound with *Milk*, but especially on the 3d, 4th or 5th day.

That is, because *Childbed Women* the three or four first days after delivery, seldom bend their Minds intently upon any business, or serious affairs, and thereupon having but very little appetite, they eat and drink less than usual, and breed less *Chyle*; but in the following days they eat more, and the *Infant* begins to cry more, and then they presently begin to think of *Nutrimment* for the *Child*, and desire to quiet it from crying. From which affection the passages being loosned by a determinate influx of *Animal Spirits*, which before were carried to the *WVomb*, the *Chylie Juice* is then converted to the *Breasts*.

XIV. And this their strong intent and frequent rumination about their *Milk*, and the sucking of their *Young Ones*, may possibly cause the *Chyle* to be the better conveyed to the *Breasts*: Which most evidently appears from what *SANTOIRELLUS* relates of a *Man*, who after the death of his *WVife*, not being able to hire a *Nurse*, one time above the rest, to still the *Child*, when it cried, took it to his *Breast*, and gave it the *Dug*, doubtless with great desire of satisfying its Appetite with *Milk*: and by this iterated application, together with an earnest intention of Mind, and the *Childs* sucking of the *Teat* from time to time, the *Chyliferous Passages* were opened, and the *Paps* afforded plenty enough of *Milk* for the *Childs* nourishment. Thus *Imagination*, and great apprehension of Danger, sometimes causes a *Man* to tremble, to be in a cold sweat, to fall into a swoon and the like.

XIII. Why the Milk encreases in the Breasts the fourth day after Child-bearing.

XIV. Imagination impells the Chyle to the Breasts.

Infants that suck the *Milk* of a *WVoman* with *Child*, become sick and weakly, and many times contract dangerous *Diseases*, as we see in too many, who by reason of the *Nurses* avarice, get a sickly habit, which shortens their days, and never ends but with their Lives.

The Reason is, because the sweetest and grossest portion of the *Alimentary Liquor* is attracted by the *Birth*, and nothing but what is ferous, and tainted with excrementitious depravity is carried up to the *Paps*. For tho' the said *Paps*, as *HIPPOCRATES* affirms, are rendred so much the larger, by how much they attract any thing of *Fat* from the *Belly*; yet in regard before *Child-birth*, the passages are too narrow for the fatter and sweeter parts of the *Milk* to pass through; therefore nothing but what is ferous and most hurtful to the *Infant*, can get up to the *Paps*.

A *WVoman*, within the verge of our memory, upon the sight of the *Naked Arm* of a lusty well-flesh'd *Man*, longed to eat some of it, and the *Honest Man* in pity to her Condition, and to satisfy her extravagant Appetite, permitted her to bite thereof: But upon her second longing he thought it too much to sacrifice his *Arm* to her ill-govern'd Appetite, and made bold to deny her; whereupon the unhappy *WVoman*, who doubtless could not help her irregular desire, overcome with trouble, fell in Labour.

Of this there can be no other Reason, than for that the *WVomans Heart*, having contracted a deep sorrow, the *vital Spirits* were diminish'd, and the *Humours* design'd for the nourishment of the *Child*, averted another way, and not conveyed as at other times to the *Womb*. So that the *Infant* destitute of that *Aliment*, wherewith the *Mother* would have had it satisfied, languish'd and at length died. For the Passages and Conveyances by which sustenance used to be conducted into the *Womb*, being shut, the *Infant* must be destitute of *Nutrimment*, and so deprived of *Life*.

A certain *WVoman* in France, being stabb'd with a *Dagger*, an *Embryo* was taken out of her *Body*, mark'd with as many livid spots as she had received stabs, and in the very same parts of the *Body*.

The Reason is, because the *Embryo*, carried in the *Mothers WVomb*, makes up but one *Body* with the *Mother*; and as it is nourish'd with the same sort of *Aliment*, so it is vegetated with the same *Spirits* according to all its parts. Wherefore no wonder if so tender a *Body* as that of the *Embryo* is subject to the same accidents as the *Body* of the *Mother* is subject; and any *Mark* or *Brand* whatsoever is the more easily impress'd upon it, in regard the *Animal Spirits*, which convey the conceived *Image*, are directed by the *Mother*, whilst she touches any part of the *Childs Body*, and as it were marks it out.

XV. Childs sucking the Breasts of a Woman with Child, contract Diseases.

XVI. The occasion of a Womans bringing forth a dead Child.

XVII. How the marks of a Woman stabb'd with a Dagger were impress'd upon the Child in the Womb.

CHAP. V.

Of Hunger and Thirst.

ALL sorts of *Animals* are some way or other, or at some time or other pinch'd with hunger; and if we should except the *Chamelion*, which is said neither to eat nor drink, there are at least none besides which feel not a *vellication* of the

7 K

Stomach,

I. How all Animals at one time or other come to be afflicted with hunger and thirst.

Stomach, and have not sometimes dry and juiceless *Jaws*.

II.
That the
Chameleon
lives not
upon the
air alone.

Before we come to discuss the Reason of this Affection in *Animals*, it will not be amiss to premise something concerning the falsity of this Old Tradition, viz. that *Chameleons* live only by the *Air*, since it is well known by experience, that they greedily receive as for a great delicacy a sort of little *Worms* pick'd out of *Meal-troughs*, and that they make use of a *Proboscis* instead of a *Tongue*, which they manage like a *Dart*, with such incredible speed, as not to be discerned by the *Eye* of *Man*.

III.
Whence
Hunger in
Animals
proceeds.

The Reason of that trouble and pain caused by *Hunger*, is the great plenty of a certain *Acid Liquor* flowing into the *Stomach*, which *Liquor* being conveyed from the *Heart* through the *Arteries*, insinuates it self among the *particles* of the chew'd *Meats*, and by diluting them, composes the *Chyle*. But when this *humour* finds nothing of *Meat* in the *Stomach* to be diluted, it exerts all its force into the *Membranules*, whereof the *Stomach* consists, and agitates the *Nerves*, whose *Extremities* adhere to the said *Membranules*, in such sort as is required to the causing of the sense of *Hunger*: Whence no wonder if the *Stomach* being empty, and the *Meats* consumed by the *Native Heat*, *Hunger* succeeds with a gnawing of the *Belly* which attends it. In like manner, all *Creatures* are affected with a desire of quenching their *Thirst* by *Drink*, whilst the ferous part of the *Blood*, which is accustomed to take its course to the *Stomach* and *Throat*, under the species of *water*, thereby to moisten those parts, sometimes also repairs thither in *Vapor*, and so dries the *Throat* and the *VWind-pipe*, and at the same time moves the *Nerves* in such a manner as is required to excite a desire of *drinking*.

IV.
Why great
drinkers of
Wine and
Strong Li-
quors are
little Ea-
ters.

Hence those that are great *Drinkers* of *VVine*, *Brandy*, or any kind of *Strong Liquors*, more or less lose their *Appetite* to *Meat*; in regard the said *VVine* or *Brandy*, being full of *Volatile Salt*, cause the ferment of the *Stomach* to be either too *volatile*, so as that over-running the most subtle *pores* thereof, it leaves the *Stomach* destitute of all *Incitement* or *Provocation*, which produces *Hunger*, or at least takes away that correspondence that ought to be between the *Salt* and that *Acid Ferment* which is required in the *Stomach* to excite *Appetite*.

V.
How Spar-
rows come
to be so
voracious.

VAN HELMONT is of opinion, that *Sparrows* are therefore so very voracious and desirous of *Meat*, as having much of acidity in the *Throat*, and the *Stomach* irritated with some pungent *Liquor*. Hence the most dry and juiceless *Meats* are commonly eaten with some or other *Acid Liquor* or *Pungent Sauce*, as *Vinegar*, *Limon-juice*, *Pepper*, *Olives*, *Capers*, *Mustard*, &c. to stir up an *Appetite*, so far as they are capable of helping the foresaid vellication of the *Acid Juice* by their own proper acidity. But all kind of *Fat Meats*, *Broths*, or *Fat Soops* soon satisfy hunger, by glutting the *Stomach*, in regard the foresaid acidity of the *Vellicant Juice*, being as it were drowned in those sort of *Glutinous Bodies*, gives not that provocation before-mentioned to the *Stomach*.

VI.
Not the
heat of the
Stomach,

By this we may easily see into the error of *Ancient Physicians*, who attribute the *Concoction* of *Meats* to the heat of the *Stomach*; and imagined

that the alteration of them was the effect of some extraordinary situation. Forasmuch as if we should take some certain *Bones* of a *Sheep* or other *Animal*, and cast some of them into a *Kettle* of *water* seething over a great *Fire*, and throw the rest to a *Dog* to be devoured; it will appear plainly to the *Eye*, that those in the *water*, tho' boiling never so fiercely for some hours, have suffered no diminution, but those eaten by the *Dog* will be found upon the dissection of his *Stomach* three or four hours after, almost wholly converted into *Chyle*; whereas it would happen quite contrary, were the *Concoction* of *Meats* performed by heat alone, since no *Man* can make any doubt, but that the heat of the *Kettle* vastly exceeds that of the *Dogs Stomach*.

Meat conveyed into the *Stomach*, and converted into *Chyle*, turns white like *Milk*.

This whiteness of the *Chyle* is effected, not by any assimilating faculty, as *Physicians* have all along, and still do commonly fancy, but by an action wholly *mechanick*; for as we see in an *Apothecaries Shop*, that many times *Fat* and *Oily Ingredients*, mixt with *Watry*, turn of a *whitish Colour*: So likewise in our *Stomach*, the Essence of the *Aliments* extracted, seems to us of an *Oily* or *Fatty Substance*, as the *drink* resembles *water*. So that no wonder, if from the mixture of these two, there ariseth a *whitish* and *Milk-like Colour*, which is the reason that the *Chyle* is always white. And as in the mixture of *Oil* and *Water*, a little *Sugar*, which is a species of *Salt*, is required to make them mix the more easily; so also in what we generally take in for sustenance, a great deal of *Salt* is supposed to be.

Or to speak more like a *Chymist*, it may be said that this *Colour* proceeds from a *Sulphureous Matter*: That is, it arises from *Sulphureous* dissolved together with *Saline Particles*, mixt with an *Acid Ferment*; for we find by daily experience, that if an *Acid Humour* be infused into a liquor impregnated with *Salt* or *Sulphur*, a white *Colour* is hereby immediately produc'd. As appears in the *Spirit of Harts-horn*, or *Soot*, imbibing a sufficient quantity of *Volatile Salt*, which being incorporated with an *Acid Liquor*, obtains a *whitish Colour*, and very near resemblance of *Milk*.

Of *Persons* that lie sick of a *Fever*, those are most difficultly cured who are great *Eaters*, especially those, who by virtue of their distemper, become more voracious than before. Hence *Physicians* observe, that those *Fevers* are more lasting, by which *Mens Appetites* are increased, but those which excite *Thirst*, shorter.

The Reason is, because thirsty people are more easily satisfied by the taking down of *Liquor*, which breathing out of the *Body* by *Sweat*, leaves nothing behind to nourish the *Fever*: But those whose *Fever* is inflamed by an *Acid* and *Salt Humour*, as being over-greedy of *Meat*, load and surcharge the *Stomach*, and so nourish the *Disease*. The appetite of *Meats* is irregular, and affects us not always in the same manner.

Some are so excessively oppress'd with *Thirst*, that all they can *drink* is not able to quench it.

The Cause of this excessive *Thirst* in the *Mouth* of *Sick Persons* is obvious; namely, when the *Salivary Vessels* are so obstructed, that they cannot discharge their moisture into the *Mouth*; where-

but the Acid
Juice per-
forms the
Concoction
of Meats.

VII.
How it is
that Meat
received
into the
Stomach,
turns white

VIII.
Persons sick
of a Fever
are the
more diffi-
cultly cur-
red if great
Eaters.

IX.
How it
comes that
some are
tormented
with un-
quenchable
Thirst.

whereupon the *Mouth* being excessively dry, and parch'd, excessive *thirst* must needs follow. Nor can it be removed, how much *Liquor* soever is pour'd in, so long as that obstruction of the *vessels* lasts.

Another Cause of *Thirst* is, when *Moisture* only is wanting in the *Blood*; but this *Thirst* may easily be expelled by a large draught of *Drink*, by reason that in this case the *vessels* are open enough. Now when the *vessels* are obstructed, to remove that obstruction, opening *Gargarisms* are to be used, that is, such as are compos'd of *Lapis Prunella*, and other *Nitrous Medicaments*.

It oft happens that persons who are very well in *health*, eat indifferently, and with little or no appetite, and can remain a long time fasting without any pain or trouble. Roger Bacon makes mention of a certain *Maid* that eat nothing for the space of twenty years; as also of a *French Priest*, who in the time of Pope *Nicolas* the 5th, lived two years without any manner of *Meat* or *Drink*.

The want of *Appetite* may proceed from several Causes, sometimes from Obstructions, that is, when the *Acid Liquor* that provokes *Hunger*, is obstructed, and denied all access to the *Ventricle* or *Stomach*: Sometimes from cold and glutinous *Humours*, by which its vigor is weakened and hindered from exercising any power upon the *Membranules*: Sometimes from the corrupt temperament of the *Blood*, whereby the foresaid *Juice* impelled from the *Arteries* into the *Stomach*, degenerates and becomes of a different nature from what it uses to be; or because the *Juice* or *Ferment* of the *Stomach* hath been thrown out by *purgatives*; whence the *Nervous Fibrils* are no longer provoked; or because the Heat or Flame (as *Physicians* call it) of the *Heart*, is agitated but with a gentle motion, and thereupon consumes but a small quantity of *Blood*; as we see commonly in *Maids* troubled with the *Green Sickness*, who being taken with an *Anorexie* or want of *Appetite*, have wholly abstained from all sorts of *Meats* for a considerable time, and without much falling away of the *Body*.

For I cannot assent to those who will have it, that *Hunger* proceeds from a *Liquor* flowing out of the *Milt*, since there is a short *Ligature* of the *Venous Vessel* between the *Stomach* and the *Milt*, which by its intumescence or rising up in a *living Animal*, hinders any thing from passing out of the *Milt* into the *Stomach*, as appears from those *Valvulae* which are in the said *Venous Vessel*; being so disposed, that tho' any thing may have a passage from the *Stomach* into the *Milt*, yet from the *Milt* through any *Veins* into the *Stomach* it cannot pass.

As to that *English Girl*, mentioned by Roger Bacon, who eat nothing for the space of twenty years, it will prove a very difficult task to make out clearly the Cause of so long and continued an abstinence from *Meat* and *Drink*, unless it be allowed, that from an extraordinary moistness of the *Brain*, a certain thin and pituitous matter flow'd down from the *Head* into the *Stomach*, which might possibly turn to *Nourishment* in the *Body*, as we see in *Dormice* and several other *Animals*, namely, *Bears* and *Brocks*, that pass whole *Winters*, and receive no sustenance from without, but

are nourish'd only by their inward *Fat*. It may also be asserted, that the *Vital Flame*, and as *Philosophers* vulgarly call it, *innate heat* in the aforesaid *Green Sickness Girl*, moved slowly, and consumed but a small quantity of that *Blood* which turns to *Nourishment* in the *Body*.

Hunger and *Appetite* is many times abated, and sometimes expelled by the taking of *Tobacco*, as we see frequently among *Soldiers* and *Seamen*, who upon the taking of a *Pipe of Tobacco*, are often very well refresh'd, and their *Hunger* satisfied.

The Reason hereof seems to be, that in the common sort of *Tobacco*, being strong and full body'd, there is much *Opium*, which keeps the *Blood* from being over *Acid*, and restrains the *Spirits* from flying away in too great a quantity: For herein *Hunger* and *Appetite* chiefly consist, that the *Acid Humours* vellicate the *Nerves* of the *Stomach*; which *Acidity*, if it be drown'd and stiff'd in the *Viscosity* of the *Tobacco*, the appetite and desire of *Meat* must of necessity cease; and if by reason of the said *Viscosity*, the *Acidity* of the whole mass of *Blood* be blunted and impair'd, consequently the fewer *Volatil Spirits* must be left; the loss whereof will be attended by debility of *Body*, and at length by death it self.

Some there are who are scarce ever satisfied with *Eating*, but are still ravening after more *Meat*; and such are they who are said to be affected with a *Canine Hunger* or *Appetite*. FRISCUS Lib. Cap. 7. makes mention of a *Woman* of a great Age, who was not able to live a moment longer than she was eating. The Emperour *Maximus*, surnamed the *Thracian*, who succeeded *Alexander* the Son of *Mammæa*, had for his daily allowance a prodigious quantity of *Meat* and *Drink*.

This extraordinary *Voracity* may proceed from two Causes, first by reason of the *Acid Juice* in the *Stomach*, so excessively abounding, that tho' *Food* be never so fast cramm'd in, yet it remains so acid and pungent, that it still corrodes the *Stomach*, and continues a violent *Vellication*; and since the *Meat* in the *Stomach* is thereupon not dissolv'd in such a manner as it ought, the *Mucilage* thereof hapning for the most part to be corrupted, comes back at his *Mouth*, and is cast off as unprofitable and superfluous *Aliment*. 2dly, This unreasonable desire of *Meat* may proceed from *Worms* which swarm in the *Belly*, and cease not to gnaw and feed upon it any longer than they are fed themselves with fresh supply of *Nutriments*. And to this purpose there goes a story of a certain *Woman*, who having voided a *Worm* of twelve inches long, return'd to her wonted moderation in eating; and likewise of another that did the same after she had voided 100 little *Worms*.

There are some, who, for several days together, feel no *Hunger*, and remain fasting without any disturbance of *Mind*.

The occasion of this is, because that *Liquor* which affects the *Membranules* with its acidity, is too dilute or weak to be capable of vellicating the *Stomach*, or because at that time it may possibly be separated from the purity of the *Blood*, or pass away into *Sweat*, either by insensible *transpiration*, or by *urine*. And this confirms the story of a certain *Man*, who being shut up under ground, and not able to get out for the space of three weeks, kept himself alive all that time by drinking his

XIII.
Hunger expelled by the taking of Tobacco.

XIV.
Some are always hungry.

XV.
How it comes to pass that some persons can live a long time without Hunger or Appetite

OWN

X.
How it comes that sometimes Persons, well in health, have little or no appetite to their Meat.

XI.
Hunger proceeds not from any liquor in the Milt.

XII.
How a Maid could live several years without Meat or Drink.

own water: For whilst he was so imprisoned, his Blood was less diminished by insensible transpiration, than when he breathed in the free Air above ground.

XVI.
How it comes that Women with Child covet the eating of odd sorts of Meats.

Women with Child, especially the first three Months, when they begin to be subject to their Breeding Qualms, delight to feed upon things of a strange Nature, and unfit for Human Food. Some delight in Tan'd Hides or Leather; some can eat Shreds of Woollen or Linnen; others Chalk, Tobacco Pipes, Cinders, or the like.

The Reason of this strange deprav'd Appetite is deduc'd from the Reason of Hunger it self; for when the Liquor which proceeds from the mass of Blood, continually takes its course through the extremities of the Arteries into the Stomach, it preys upon it, as hath been said, for want of Food, by agitating more vehemently than usual, the Filaments of its Nerves. But if the said Humour be of that Nature as to exert its ability rather upon some meats than others, after the same manner as Aqua fortis more easily dissolves Metal than Wax; it thereupon affects the Nerves of the Stomach with some singular quality or other. Whence it comes to pass that the Soul inclines to some sorts of Meat rather than others, and at such time as aforesaid, most vehemently covets, what at another time it would loath.

XVII.
Why some that are great eaters, never theless are spare and lean.

Some Persons, tho' they eat much, yet are never the fatter, but always thin and lean: Others on the contrary, eating but little, grow very fat and corpulent.

The Reason is, because some people consist of a Fibrous Blood, and their Fibres are of a very soft and pliable contexture; so that by the accession of new Fibres, their Flesh must needs become inflate and loosened into a fat consistence. Whereas those that are lean have drier Fibres, and which consist of a harder contexture; which being incapable of access or addition, cannot be augmented or dilated.

Another Reason is this, because too great quantity of Meats devoured, cannot well be fermented or attenuated; whereupon there arises a thick and viscous Chyle, which being conveyed to the Lacteal Veins, and by reason of its thickness not being able to pass, is forced to stop, and this stoppage produces obstructions, which hinder the Chyle from passing freely to the Blood. So that no wonder if some great Eaters are frequently leaner than those of a sparer and more slender Diet.

XVIII.
Why after Meat some feel more cold than before.

It is a common observation, that many persons are more cold than ordinary after Meat.

The followers of GALEN alledge for a reason, that the beat draws inward, and returns toward the Heart; but we rather assert, that the true reason of this cold is, because the cruder part of the Chyle transmitted from the Stomach and Intestines through the Lacteal Vessels to the Blood, diminishes in some sort the rarefaction thereof in the Heart, and hinders the Blood from being carried with such a force as it was wont, to the solid parts; whereupon the Vapors arising from thence into those parts, meet some stop, and thereby the Fibrils suffer a tremour of the parts less than usual, and herein consists the reason of the Cold.

CHAP. VI.

Of the Motion of the Heart, and Circulation of the Blood.

Physicians observe, that Respiration is hindered by Laughter, and if it be excessive, that then the Motion of the Heart, and Circulation of the Blood is stop'd.

The Reason is, because in Laughter the Diaphragma or Midriff seems to be driven by the Muscles of the lowermost Ventricle, which press the Entrails upon it, upwards as far as the Cavity of the Breast, and with a tremulous progress to be relax'd or loosened, as it were to expel the Air by parts, for the forming of a Laughter within the Larinx, whereby it comes to pass, that adhering to the very Pericardium, it drives up the heart, and its Basis close to its Vessels, as well where it uses to take in the Blood, as where it lets it out: So that the Doors, as it were, of the Heart being shut up, the Circulation of the Blood is for a time intermitted, as plainly appears from a swelling of all the Veins in the Neck, Face and Forehead. That this is the real Cause, may certainly be hence collected, namely, because in long fits of Laughter, especially in young Children, they look black in the Face, from the over abundance of Blood, because of the stoppage of its course, and even Death it self sometimes puts an end to these over gamesom Frolicks.

Some things accelerate the Motion of the Blood, as a Fit of a Fever or Ague, and an over-large draught of strong Wine.

The Reason hereof in Fevers is, not because the Blood, with an excessive ebullition, flies up into the Aorta, but because its situation and sense of heat, hurtful to the Ventricles of the Heart, being transmitted to the Cerebellum or hinder part of the Head, provokes the Spirits to accelerate its motion sooner or later, as occasion requires. Partly also because some parts of the Blood thus roused and carried into the Brain, exagitate the Spirits there abiding, and raise them as it were into a mutiny; so that those parts that fly up into the Brain from high drinking of Wine or other strong Liquors, stir up the Inhabitants of the said Brain into the like tumults.

A Heart taken from the Body in some Animals, leaps and discovers a sensible motion; nay, and sometimes, tho' dissected and cut into small pieces, it does not presently cease from motion, but beats for some time after, especially in Fishes, whose Hearts move longer than those of any Terrestrial Animal. But how can it be that a Mans Heart can borrow its pulsation from the Soul, when-as the Soul is indivisible, and hath not parts of its own, separate from the Body. We may better attribute this Motion, as well in Man, as in other Creatures, to the Blood contained within the Fibres, which Motion in the Heart is oft-times discerned by the Eye, or may be supposed to lurk, or lie hid within the Fibres of the Heart. For a very small portion of Blood flowing from one part of the Heart to the other, being a little hotter, suffices for the effecting of this Pulsation. For by how much the less the quantity of any Liquor is, so much the more easily it rarefies, and is dilated. And as some Members of our Body so much the more easily repeat

I.
How Laughter comes to hinder the Motion of the Blood.

II.
How an Ague, or large draught of Wine accelerates the motion of the Blood.

III.
How it is that the Heart of some Fishes, severed from the Body, moves, and sometimes thro' out in pieces.

repeat any *motion*, by how much the more frequently they have exercised it before: So the *Heart*, in regard it hath been accustomed to the *Diastole* and *Systole*, from the first moment of its formation, may be impelled by the smallest force imaginable to continue it. Whereupon since some *Constituents* of the *Blood* are dispersed in the *Hearts* taken out of the *Body*, it comes to pass, that upon their being dilated by *heat*, the *Hearts* for some time beat, and by turns rise and sink.

IV.
This appears in the Hearts of Eels and other Animals.

This is more particularly discern'd in the *Hearts* of *Eels* disliver'd from their *Bodies*, in which *Hearts* some *pulsation* still remains for a time, that is, because the *Spirit* of those *Eels*, implanted in their *Hearts*, is by a small heat easily raised into *Act*, and thereby acts upon the *Blood*, inhering in the substance, and by dilating it in some measure, contracts the *Fibres*, after which that dilated matter being a little dispersed, the said *Fibres* are again loosened. And this appears not only in *intire Hearts*, but also in the *Hearts* of some *Animals* dissected into pieces, and that in every several *particle*, as in each whereof such a dilatation happens about the dissected *Fibres*.

V.
The Pulse of an Artery is stopp'd when the insertion of a Pipe or Quill into it.

Upon the thrusting of any *solid Body* into an *Artery* to stop the course of the *Blood*, immediately the motion of the *Artery* ceases; nay, if a *Silver Pipe* or *Quill* be put into the incision of an *Artery*, and the *Artery* be bound about with a *Fillet* thereupon, the same effect will immediately follow, altho' the *Blood* pass through it.

The Reason of the first Experiment is plain, because the *pulse* of the *Arteries* is made by the *Blood*, rarch'd by turns, and flowing into the *Arteries*, that is to say, whilst the *blood* of the great *Artery*, possessing the place of that next the *Heart*, thrusts forward and agitates all the rest of the *blood* contained in that *Artery*, and its *Branches*. But a thick *Body* being thrust into the *Artery*, the course of the *blood* is stopp'd; and that portion of *blood* entering the *Aorta*, is not able to thrust forward the other parts contained therein. As to the 2d Experiment, there must be a distinction to explain it aright. For either the *Pipe*, thrust into the *Artery*, is of such a thickness as to fill the whole capacity of the *Artery*, and thereby to be so join'd to its internal superficies, as that it may not be able to overtop the *blood*, and to have so narrow a cavity within, as that it cannot without great difficulty be penetrated by the *blood*. In this case it is evident, that the *Pipe*, tho' free from any sort of bending, will stop the Motion of the *Artery*. Or else the *Pipe* thrust into the *Artery*, is of that Cavity as to afford a free passage to the *blood*; and then whether it be bound with a *Fillet* or not, it will no way hinder the *pulsation* of the *Artery*.

VI.
Why the Blood runs quicker in the uppermost parts of the Body, slower in lowermost.

The *Blood* hath a quicker course in the upper parts of the *Body*, than in the lower.

The Reason is, because in the upper part it flows easily into the *Heart* without help, (for the most part) of any thing else; but not in the lower part, except by the impulse of the *Arterious Blood*, and sometimes by reason of the contraction of the *Muscles* it exerciseth, it is not without difficulty driven upward. And therefore of necessity the *Circulation* thereof must be quicker in the upper parts.

VII.
Why the Veins have no Pulse.

The *Veins* have no *Pulse*, notwithstanding they are no less full of *blood* than the *Arteries*, and as well convey into the *Heart*, the *blood* returning from the whole *Body*.

The Reason is, because the extremities of the *Veins*, by which the *blood* enters, are narrower than their *Channels* into which it flows, whereby it comes to pass, that by passing from a narrower place into a broader, it loses a great part of its force and vigor: Whence tho' it may fill the *Veins* with a continual afflux, and make them swell, yet it cannot agitate them with continual subsults, so as to be sufficient for the effecting of a sensible pulsation.

If a *Mans Arm* be so bound, that all the *Veins* which tend thither, (by reason of the pressure of binding) are so obstructed that the *blood* is denied all farther access to them; that *Arm* in a short space will swell and be puffed up to a high degree; but afterwards if the *ligature* be not loosened it will dry up and wither.

The *Veins* being bound, the *Arm* swells and is puffed up beyond its usual pitch, because the *blood* flows from the *Arteries* into those *Veins*, and not finding a passage, cannot but inflate them, and increase their bulk; but by little and little this tumor is diminished, and the *Veins* grow flaccid, because the *blood*, stagnating in the *Veins* so bound up, becomes in a short time more gross; and by reason the *Ligature* presses the *Veins* too long, not only the *Branches* of the *Veins* are obstructed, but also the passages of the *Arteries* are also shut up, and hindered from any farther transmitting the *blood* into the *Veins*. Whence the serous part of the *blood* therein contained, evaporating by insensible transpiration, the *Arm* must needs fall from its swelling, dry up and wither.

We find by experience, that during the *pulsation* of the *Heart*, sometimes all the *Arteries* beat, even to the utmost extremities of them, and sometimes that they do not all beat.

When the *pulsations* of the *Heart* are very great and perceptible, then the *Arteries* are perceived to beat sensibly; but when the *Pulses* are small and languid, then there is perceived no sensible motion in the extremities of them. Whence HARVEY upon very good ground and consideration, observes as followeth; The impulse of the *Heart*, saith he, is diminished as it were in all its parts, at every division of an *Artery*; so that at the last division, the *Arteries* in a manner becoming *Capillary*, are like to the *Veins*, not only to their structure and tunics, but also in their rest, and cessation from beating, since they have no sensible Pulse, or at least not always, except when the *Heart* beats very vehemently, and the *Artery* that attends is over-much dilated. And this is the Reason why we sometimes feel a *Pulse* at the *Fingers* ends, and sometimes not; and from hence Dr. HARVEY commonly made his indication of a *Fever* in *Children*, when he sensibly perceived a *pulsation* at their *Fingers* Ends.

Women, when they arrive to a certain Age, have a flux of blood every Month.

The Cause of this *Profluvium*, some attribute to a *Nitrous Salt* which excites a fermentation in the *blood*: Whence the *Orifices* of those *Tubuli* which reach to the *Womb*, being dilated by an effervescence, or as it were boiling of the *blood*, draw the said *blood*, and as freely refund it back again. But when the *blood* flows without any stop, the *Ferment* reinforcing, dries it up, much after the same manner, as *water* gushing forth, casts out the

VIII.
The Veins being bound, the Arm swells, and with continual Ligature dries up.

IX.
During the pulsation of the Heart, all the Arteries do not always beat.

X.
Whence Women have their Monthly Fluorae.

the *Nitro* which it washes out of the *Earth*. Then the *Womb* being reduc'd to its former state, the same *Ferment* is rais'd in the same manner as formerly, and if not hindred, being collected together in the same space of time, and in a like quantity, and advanced to a like exaltation, produces a new *Fermentation* in the *Womb*.

XI.
Why sometimes dying Persons live for a time without any circulation of the Blood.

Persons at the point of *Death*, oft-times live a considerable while without any circulation of the blood. This is most intelligible to *Anatomists*, who in their dissection of *Bodies*, often find the *Vena Cava* empty, and wholly destitute of all *Sanguineous Liquor*.

This may well enough be, by reason of the contraction of those vessels which serve for the transmitting of the blood. For tho' the blood of a dying Person is first refrigerated in the lesser *Veins*, and farthest distant from the *Heart*, and then thickned for want of heat; and thereupon the wonted motion of the blood passing out of the *Arteries* into the *Veins* is stopt; yet the *Vena Cava* may nevertheless be able to contain something of the *hot* and *fluid blood*; which by contracting it self, serves for a *fomentation* to the *Heart*, in the same manner as a *Hogs-bladder*, blown up and distended by the *Air*, the *Mouth* being taken off from the *Ureter*, expels by a spontaneous contraction, and drives forth part of the said *Air*. Forasmuch as the *Life* of the *Dying Person* is no other way ended, but upon the ceasing of the circulation of the blood: Since all the *vital sustenance* contained in the *Vena Cava* is consumed, and the *Vena Cava* dispossessed of the blood.

XII.
Why in strangled Persons the Arteries are found to be void of Blood.

Hence it comes to pass, that in *strangled Persons* or *Animals*, the *Arteries* are wholly destitute of blood, when as at the same time the *Veins* are filled. For when the motion of the *Lungs* begins to fail, and the motion of the *Heart* still continues vigorous, the blood is forcibly ejected out of the left *Ventricle* of the *Heart* into the *Arteries*, and yet at the same time no new blood flows out of the *Lungs* into the said *Ventricle* of the *Heart*. Hence in a short time the *Arteries* become empty; a great argument nevertheless that at every pulsation or beat, the blood flows plentifully from the *Heart* into the *Arteries*: Whence upon the binding of the *Aorta* near the *Heart*, the *Carotides* or *Arteries* in the *Throat* seem empty, not the *Veins*; whence it appears, that the blood flows not out of the *Veins* into the *Arteries*, but rather out of the *Arteries* into the *Veins*.

XIII.
Why Surgeons tie the Arm in Blood-letting.

Surgeons when they let blood, bind the Arm in different streight, above the place where they design their incision, to the end the *Veins* may swell the more, and the blood issue out more freely.

The Reason is plain to those that admit the circulation of the blood in *Human Bodies*; forasmuch as a gentle binding cannot hinder the blood which is in the Arm from returning to the *Heart* through the *Veins*, nor new blood from being always impelled by the motion of the *Heart* out of the *Arteries* into the *Veins*. For the *Arteries* are placed beneath the *Veins*, and their skin is harder than to be compressed or bent by any slight ligature or pressure; besides that, the blood proceeding from the *Heart*, strives with greater force to advance through the *Arteries* towards the *Hand*, than to return from thence to the *Heart* through the *Veins*.

This may be proved by another Experiment: For if upon the swelling of the *Veins*, for example of the *Hand*, the blood be pressed by the *Finger* towards the *Branches*, the *Vein* towards the *Branches* swells, the *Trunk* in the mean time falling, which immediately upon the drawing back of the *Finger*, rises and becomes inflate; that is, because the motion of the blood inclines from the *Branches* towards the *Trunk*, which while it is hindred by the apposition of the *Finger*, the *Trunk* must of necessity grow flaccid, and the *Branches* swell: Whence, when-ever it happens, as in a *Plurisie*, that the passages, for the conveyance of the blood through the whole *Body*, are streightned, the Person is in danger, unless immediate *Pblebotomy* be applied, by which the pores of the *Intercostal Capillaries* are at length opened, and the blood regains its accustomed passage.

XIV.
An Experiment proving the motion of the Blood.

Some *Animals* having their *Heart* cut out, still move, as *Lizards*, *Eels*, and the like. I have seen a *Frog*, which having its *Heart* taken out, remained some time alive.

XV.
How Animals live some time after their Heart is plucked out.

The Reason possibly may be, because motion in *Animals* is effected by means of the subtiler parts of their blood which pass from the *Heart* to the *Brain* through the *Magna Arteria* or great *Artery*. But when there is a great abundance of those subtle particles in the *ventricles* of the *brain*, it happens that the *Frog* remains alive for some time. Since no doubt but new *Spirits* have flowed from the blood contained in the *Arteries*: But if the *Head* be cut off all motion thereof immediately ceases, because then no more *Spirits* can pass from the *Arteries* into the *Muscles*. So that if any parts of these *Animals* still move after the *Head* is cut off, it proceeds from the *Spirits* only, which yet a while adhere to the *Muscles*, as is to be seen in the *Tails* of *Lizards* cut off; and in *Pidgeons*, who having their *Heads* pluck'd off, still move their *Wings* and *Feet* for a good while, in regard the *Animal Spirits* are still fluttering in those inferior parts, and by those aforesaid intermediate Canals, tend from one *Muscle* to another, until at length they are dissipated, and after that their motion wholly ceases.

CHAP. VII.

Of the Actions of Animals.

THE *Badger* *Ajacobulus* or *Tatus* in *Brasil*, lies with his *Face* upward in rainy weather, and takes in the water by a large passage into the *Belly* between the *Ribs*, that looks like a little *Pool*, and so continues after the shower is over, sometimes for a whole day together, or till such time as the *thirsting Hart* coming near by chance, sets his *Mouth* to the *Imagined Pool* to drink, which the said *Badger* perceiving, catches hold of the poor *Beasts Mouth* and *Nose*, and never lets it go, till tired with struggling it loses its *Life* together with its wasted *Spirits*.

I.
How the Badger deceives the Hart.

The *Fox* is a very crafty Creature, who sometimes counterfeits himself dead, and lies without all sense of motion, till the inveigled *Geese* and *Hens* approach so near that they are easily snapt and devoured by him.

II.
How the Fox deceives the Geese and Hens.

Many hereupon attribute Reason, however imperfect, and as they call it *Umbratile*, to *Brute Beasts*,

Beasts, by which they manage their *actions* and effect their *designs*, with a semblance of *Cogitation*. And to this Opinion they are induc'd by their being induc'd with *Tongue*, *Ears*, *Eyes*, and other *Organs of Sense*: From whence they conclude, that they have a perception like to that of ours. For since in our way of *Sensation*, *Perception*, or *Cogitation* is included, they will have it that the like sort of *Cogitation* is also to be attributed to them. But these men seem not sufficiently instructed in the nature of *Cogitation*, when they assign it to *Brute Animals*: Forasmuch as those effects of sensibility mentioned, are proper as well to the *Body* as to the *Mind*. Otherwise all other *Animals* might be asserted to be equally indowed with *Intellect* and *Will*, and must of necessity be judged, not only *equal*, but even *superiour* to *Mankind*; since we find that they comprehend objects at one view, and attain to what they design the very first time they attempt it; a thing scarcely to be allowed, even to the wisest of *Men*, who make their conclusions and results, not without long *Discourse*, *Study* and *Cogitation*, which these *Creatures* at once, and by a simple apprehension attain to.

III. There are affections in Brutes, but not reason.
I acknowledge indeed certain *affections* in them, by which they are impelled to the performance of their *actions*, but not *Cogitation*, and the *modes* of *thinking* proceeding from it. So the *Badger* lying on his Back in the open *Air*, to retain the *Water* which the *Rain* had poured into his *Belly*, as it were into a *Trough*, and being wakened by the approach of the *Hart* to *drink*, is led by instinct to catch hold of his *Mouth*, by the closing and shutting together of its strong Coat of *Mail*, to get possession of his *Prey*; and afterwards calling to mind the said accident, he might from time to time, as often as *hunger* urg'd, make use of the same stratagem for the getting of new *provision*. All which things might very well be effected, without the help of *Reason*, *Design* or *premeditation*, but only by the disposition of the parts of the *Body*, and the frame or structure of the *Organs*.

IV. How Brutes come to have a memory.
Brutes indeed have a *memory*, not by virtue of a *Rational Soul* or *Mind*, of which they are destitute, but of motions formerly received by tracts heretofore impressed by the sense upon the *Brain*, which *motions* are presented again singly to the common *Sensorium*.

V. Whether the Dogs make any rational choice in following their Game.
Dogs oftentimes having lost the *Scent*, are at a stand, and if it happen that there are several *ways* or *paths*, for example three, having by the *smell* try'd two, they fall into the third without any demur, not in the least doubting, but certainly assured that the *Deer* or *Fox* hath taken that course.

This *Action*, which seems to carry some semblance of *Reason* in it, is only the work of a *Corporeal Organ*. For the *Dogs*, while they pursue the *Deer* with extraordinary earnestness, it may possibly happen, that they may make but a slight search in the first *Path*, and then leaving that way betake themselves to the search of the others, but finding therein no tract of the *Beast*, may lastly return again to the first, wherein the *Scent* being recovered, and all demur set aside, they follow the track, and at length catch the *Beast*.

VI. How Dogs know their Masters.
Dogs in a mixt Company of men, keep close to and follow their own *Masters*, as knowing and distinguishing them from other *Men*.

Of this there can be no other reason given, than because from divers persons different exhalations arise, which the *Dogs* discerning, are affected with none so much as those which exhale from their *Master*, as being longer accustomed to them. For these *particles* exhaling from the *Body* of the *Master*, so affect the *Fibrils* of the *Nerves* that are extended into the *Dogs* *Nose*; that thereupon there follows such a concurrence of the *Animal Spirits* into the *Muscles* of the *Dog*, as disposes him to fawn upon his *Master*.

Camels, that delight very much in *Musick*, are oft-times taught to *dance*: Some have been seen to keep exact *Time* and *Order* in their *movements* at the sound of a *Drum*, sometimes in a round, sometimes meeting, sometimes falling off.

Their manner of *Institution* in this faculty was thus. When they were yet young and tender jointed, they were shut up in a *Hot House*, whose *Pavement* was on purpose heated; then just before the *Door* there was a *Tabour* or *Drum* beat, mean while the *Beasts* not well induring the heat of the *Floor*, lifted up sometimes one *Leg*, sometimes another, and by such a continual *motion*, were forced to bestir themselves. This *exercise* being thus continued for divers *Months*, they were so accustomed to it, that when-ever they came in publick, and were brought forth into the open *Air*, at the sound of a *Drum*, on purpose beat, they lifted up their *Legs* according as they had been accustomed, but with a *motion* somewhat more regular than what they had been used to, as being now more unforced, and so framed a compleat *Dance* in exact *time* and *measure*.

A *Hen*, when she calls her *Chickens*, *Clucks*, when she warns them to flight by reason of the *Kite*, she holds it out longer and advances it louder, when taken she vehemently, and, as it were, repeats a fobbing *tune*: When she laies an *Egg*, she *Exults* or *Cackles*; when she hatches her *Eggs* to produce the *Chickens*, she utters a rougher, thicker and slender *tone*, than when she calls them to her; when she broods over her *Chickens*, she uses a lower and more depressed *voice*, and different from all the rest.

This diversity of *sounds* which is observed in *Hens* and other *Animals*, proceeds from their various *affections* or *passions* which move them and alter the disposition of their *Body*. For whereas the *Voice* is produced by the emission of the *Breath* out of the *Mouth*, through the *Aspera Arteria*. It is apparent that according to the various disposition of the *Instruments* which conduce to the forming of the *Voice*; peculiar *Voices* or *Sounds* must needs arise. And since according to the different *passions* wherewith they are moved, the *Organs* obtain a different disposition: Hence it comes to pass that *Animals* utter different *Voices*, and signify by various *Tones* their trouble or delight; which *Sounds* being conveyed to *Animals*, either of the same or different kinds, variously affect them. So the *Howling* of a *Baboon*, toles the rest of that kind, tho' remote from him, and calls them to his Aid. So a *Hog*, when he is set upon by *Dogs*, by his loud *grunting* and *crying* out, calls the neighbouring *Hogs* to come and help him. So a *Hen* by its different *pipations*, signifies its various passions, according to the various disposition of the *Vocal Organs*, which the predominant *passion* produces.

from other Men.

VII. How Camels are taught to Dance.

VIII. Whence proceeds the diversity of tones in Hens.

duces in its Heart. So that whoever will penetrate into the Nature of *Brute Animals*, and dive into their most hidden *affections*, may easily and without labour discover the reason of their several *Cries* and *Vociferations*, and unfold by what motion of the *Heart* they are impelled; as I have more at large made out in my *Dissertation* of the want of *Sense* and *Knowledge* in *Brutes*.

IX.
The reason
of the Craft
used by
Hares to
avoid the
Dogs.

Hares, the better to elude the quick *Scent* of the pursuing *Dogs*, confound their *Tracks*, by shifting and traveling from one course to another, and most especially they avoid *shrubby* and *brambly* *Places*, lest by rubbing off their *Hairs* against them, they should afford the stronger *Scent* to the *Hounds* as they pass by. Sometimes they betake themselves to *Hedges*, where they lie and skulk; sometimes they run into the midst of a flock of *Sheep*, that so the *scent* of their *Bodies* may be drown'd and lost by the overpowering *scent* of so many other *Bodies*: Nay if they are overmuch pressed by the *Dogs*, they come back the same way again, or by a huge leap bounce into their *Cave* or *Lodging*.

All these *tricks* which are ascribed by some to the Craft and Policy of the *Hare*, are only the effects of their *Fear*. For what can be more obvious to *Hares*, when the *Hounds* pursue, than to have recourse to places of retreat, and by their shelter to preserve themselves from their *Enemy*? When there are no *Woods* to fly to, haply *Herd*s of *Deer* or *Flocks* of *Sheep* present themselves to *Eye*; thither then immediately they run, and intermingle themselves for refuge, till by the cry of the *Hounds* they find themselves freed for the present, and so continue their flight homewards; or if they take their flight, as soon as the *Dogs* are in pursuit, it is to be imputed to their fear. By which the *Spirits* of the *Brain* being agitated, will not suffer them to sit down in quiet, and neglect the imminent danger. As we see in persons tired and wearied, who not having an immediate opportunity of *resting*, are forced still to keep moving a little, by reason of the commotion of the *Spirits*, which haply is the cause that *Hares* by reiterated *Vaultings*, leap to and fro, and springing high in the *Air*, recover their abodes: Nor can there be any other reason given why tired *Hares* make so many *windings* and *turnings*, oft-times repeating the same *Tracks* over again; but because hurried with overmuch fear, they become affected with great distraction; and are thereby diverted from their first intended *course*, unless the *Hounds* in their close pursuit are so inevitably hard upon them, as to force them back into their first *Path*.

X.
How Birds
with such
Art and
Order build
their Nests,
and bring
up their
Young Ones.

Birds are indued with wonderful ingenuity in the bringing up of their *Young*; for presently after *Copulation*, their main business is to build their *Nests*; they pick up *Moss*, *Chaff*, *Straws*, *Feathers*, &c. with which they build their *Nests* round; and having laid their *Eggs*, they sit upon them, hatch their *Young*, and in a short time teach them to fly.

All these things may be effected without the help of *Reason*, for it is certainly natural and innate to *Birds* to couple at certain set times, and to this they are impelled, either by the *Season* of the year, or by the *Meats* upon which they feed: Likewise certain it is, that *Eggs* are produced from *Copulation*, which being shut up in the *Belly* of

the *Female*, cannot but be burthensome to the bearer of them; as soon as they are arrived to any magnitude, whereby it comes to pass, that desiring to unburthen themselves of them, they choose a place fitting wherein to lay them, and underlay it with the softest things they can procure, and which are especially grateful at that time by reason of the weight of the *Eggs*; and all this by no other conduct of *Reason* than *Cats* and *Dogs* make use of, when upon the approaching time of their *Whelping* or *Kittening*, they seek out a place commodious for the bringing forth of their *Litter*. The *Eggs* being laid, they sit upon them, by reason of a certain contexture of the *Fibres* at that time whereby they are disposed hereunto, as we see in *Hens*, which at a certain time of the year, sit cowering on the *ground*, as if they were sitting over their *Eggs*, when as indeed there are none under them; which plainly shews, that at that *season* they are affected with a certain indisposition which brooding eases and removes. Whence it appears that all these things are not effected by *Katiocination* or *Cognition*, but by the motion only of the *Spirits*, and the disposition of the other parts of the *Body*. In like manner as artificial *Fountains*, *Clocks* and such like *Automata*, wrought by *Human Ingenuity*, which perform many things that cause wonder, and all by the orderly structure of their parts only.

The *Castor* or *Beaver*, an *Amphibious Animal* in *Virginia*, thus fortifies it self against the force of the approaching *Winter*; they choose a place upon a declining *ground* near a *Rivers* side, against which with great *Industry* and *Labour*, raising a kind of *Bulwark* with *Turf*, *Boughs* of *Trees* and the like, they stop the course of the *water*, and make a little *Lake* or *Pool*; and about the Head thereof they choose a little rising *Hillock* whereon to build a *Cottage* or little *House*; on the topmost part whereof they leave an open *Portal* for the *Air*, here they lay up *Boughs* cut from *Trees*, on which they feed; moreover digging *Mines* under the *water* to pass to and fro, when and where they please, they bid defiance to all the *Hunters* Arts.

And all this may be performed both by *Beavers* and other *Creatures* without the help of *Council* or *Rational Cognition*, but by a certain blind impulse of *Nature*; for if *Cognition* be allowed of in these *Creatures*, it may as well be allowed of in a *Vine*, which as if it foresaw its inability to sustain its future burthen, hath recourse to the *Elm*, which it catches hold on for a *Prop* to bear the load of those heavy *Clusters* it must hereafter bring forth, and winds about it with its wreathed tendrils, as with so many grasping *Hands*: Or as in the *Stomach* either of *Man* or *Beast*, wherein the *Aliment* is so digested, as if by foresight and design there were made a distinction between the profitable and unprofitable *Juice*, and a distribution ordered accordingly, part being sent out to the intestines, part to the *Heart*, thence to be conveyed to the *Limbs* and *Head*, according to the several occasions and necessities of each part. And certainly since the fore-mentioned *Animals*, build their *Habitations*, and manage all other affairs by the same impulse; it is a great argument that this proceeds from *Nature*, that is, from

XI.
How the
Castor
in his
Cottage.

XII.
That there
is no power
of Cogitation
in
Brutes than
in a Vine,
or in the
Stomach.

from the disposition of the *Organs*, rather than from any rational *Cognition*.

XIII.
How the
Remora
puts a stop
to Ships in
the Sea.

The *Remora* retards a *Ship* under *Sail*, and stops its *Course*. An instance whereof we have of a *Ship* of *Francis*, *Cardinal of Turon*, sailing from *France*, and stop'd in its mid course, from the Relation of *Petro Melata* of *Bononia*.

This so great force of the *Remora* baffles the subtle apprehension of all the *Philosophers* I ever yet read of, who frankly acknowledging the slenderness of their understanding, profess themselves wholly ignorant of the cause of this so stupendous matter, and have nothing but that *Assylum* of *Asses* to have recourse to, their *Occult Quality* forsooth: Nor is it without Reason that they are at this loss; for indeed it must be a very difficult thing to be resolv'd of the Reason of a thing that never was. For if the Writings of Authors that make mention of the *Remora* be seriously considered; it will plainly appear that what they delivered concerning it, depends not upon their own Testimony or Opinion, but is taken upon trust from others. Whence *ARISTOTLE* in his 2d Book of *Natural History*, having delivered all he had to say concerning the Nature and Qualities of this Creature, adds at last, as some relate, *PLINY* writes in his 9th Book; *This Creature sticking to the Keel, the Ship is supposed to move the slower*: And *Plutarch* in his *Symposia*, *Some*, saith he, *there were who laugh'd at this tradition of the Remora, as an Idle and Fabulous Story*. And many others there are, too long here to recount, who believe the Story of this Fish to be but the subject of an Idle Fiction imposed upon the credulity of Mankind.

But that *Ships* have been hindred on a suddain from Sailing is not denied. Must therefore a little *Feeble Fish*, which according to *Aristotle*, is but a kind of *Murex* or *Purple Fish*, and like to a *Snail*, effect so great a wonder? Why may we not as well impute it to a suddain *Ebb* of the *Sea*; such as in the Bay of *Sicily* divers have had experience of, by which *Ships* in their full career of *Sail* have on a suddain been retarded and rendred wholly destitute of Motion? Who knows not that very vehement gusts of *Wind* sometimes break forth in a moment from the bottom of the *Sea*, and with a vast force drive against the *Stream*? Do not such accidents as these suffice to retard *Ships* under *Sail*, without the help of a poor despicable little Fish? Doubtless they do, and I cannot but positively look upon them as the real cause of the *Ships* immobility. Besides if the *Remora* be able of it self to act such a wonderful thing, why may it not as well do the same being received into the *Ship*? Since it is reported of it, that it hath been by the Mariners taken sticking to the *Rudder*, and brought into the *Ship*. Which was the very observation of the Emperour *Cajus*, who sailing from *Affura* to *Antium*, when a *Remora* that was said to have stuck to his Gally, was taken and brought into it, wondred why it could not then as well do the same thing, and transfuse its virtue as well within as without.

XIV.
How Brute
animals
come to pre-
sage ap-
proaching
Weather.

Brute Animals foretel Winds, Fair Weather, Rain, &c. *Hedgehogs* drawing in their *Quills*, are a great sign of Stormy Weather; *Halcyons* betaking themselves to their *Nests*, betoken a Fair Season: All tame Fowl, as *Ducks*, *Geese*, *Game-*

Cocks, &c. give certain presages of change of Weather.

This faculty they have from a perfect disposition of their *Organs*. For since there are in the Air certain prognosticks of future Weather, Brute Animals by reason of that vigour of some Senses more than others, with which they are indued, more easily presage those Seasons than Men, whose Imaginations are taken up with variety of Objects, and whose common Senses are not altogether so sharp as those of Beasts. However they cannot properly be said to foretell any more than Warts on a Mans Toes, or Limbs out of joint can be said to be indued with præsience, or the knowledge of future things.

Whatsoever Dislocation, Fracture or Solution of Parts happens to be in any Member of the Body, portends by a greater pain at that time than any other, a Stormy or Wet Season; but especially that Venereal Distemper, that with a far more exceeding pain attends persons of a lewd and incontinent course of Life: Forasmuch as these Men, when the Northern Winds begin to blow, are sooner assaulted with those pains, in regard at that time their Nerves are intended and their Muscles grow stiff, and are cruelly tormented with those vitiated humours that are rivetted in the Members; for in these parts chiefly lurks the said Distemper, which influenc'd by the Season, exercises a kind of butchery in the inmost recess of the Body. By the same sensibility of Weather, Frogs Croaking more than usually; Swine routing in a bundle of Hay; Cows and Oxen holding up their Snouts to the Sky, and snuffing, presage Rain from the humidity of the Air.

XV.
How Men's
Bodies pre-
sage Storms
and wet
Weather.

CHAP. VIII.

Of the Aversion and Affection of Animals.

THE Basilisk hath that kind of pernicious Venom, that it is said to destroy a Serpent, tho never so great, by breathing upon it: Nay, if credit may be given to Historians about this matter, if it espy any Man approaching to its Cave, it kills him with its looks.

I.
Whether
the Basilisk
be mischie-
vous in its
looks.

I cannot easily persuade my self that the Basilisk can prove so mischievous to Mankind with its Eyes only; for how should it come by so fatal a malignity in its Looks? With what a vast force must Rays be darted from his Eyes, to pierce quite through the whole Body of Man, and destroy him even at a distance? But I am rather apt to believe, if what is reported of the Basilisks fatal pretence be true, that the killing stroke he gives, proceeds not so much from Spirits darted from his Eyes, as from the pestiferous blast of Breath blown out of his Mouth. Since it is certain, that he causes Trees and Shrubs to wither and die; breaks Stones, blasts Herbs, and that not by contact only, but parches and burns them up by his Breath. Hence all other kinds of Serpents dread and shun his poison, and fly him as a Common Enemy of all Creatures: And as such a one *Lucan* describes him in his 9th Book, where among other things of him he saith,

Lord Paramount he reigns of th' empty Sand,
And from him drives all Creatures near at hand.

II.
The same is
done by
Dragons.

Well therefore may such a destructive Breath as this, blown out of his pernicious Mouth, and lighting upon any Man as he chanceth to pass by, penetrate through his whole Substance, by its subtil and virulent quality, and by inverting the contexture of the Fibres, so afflict him, as to render him less capable of performing the Offices of Life. The same is related of Dragons in the time of Philip, King of Macedon, for that the Soldiers passing through two Mountains, fell dead as they marched.

The Reason, as Socrates reported was, that by his prospective Glass he discerned two Dragons, one upon each Mountain, breathing forth their Venemous Breath one against the other: By the power whereof whatsoever went between escaped not Death: For this story we have the authority of Libanius De Origine Rerum.

III.
Of the Be-
naming
Fish.

There goes a Story of a Fish in the Island called Cayenne, not much unlike a larger sort of Eel, which by touching the utmost end of the Fingers, or the very Staff or Stick held in the Hand, strikes a numbness through the whole Arm, and the parts near about it, accompany'd with a kind of Scotomy or heavy dimness of Sight. It is also related of this Fish, that to make a prey of other Fishes, and prepare them for his Tooth, he strikes them with the extremity of his Tail, and so benumbs them into an irresistence. This Mischief is to be imputed to the virulency of those Breathings, Evaporations and Effluviiums which proceed from these Creatures; much like those that steam from Aqua-Fortis, Quicksilver, and such like sort of Minerals.

IV.
Why the
Lion
dreads the
Voice of the
Cock. The
Elephant
that of the
Sow.

So great is the Antipathy between the Cock and the Lion, that the noise of his Crowing, or the very fluttering of his Wings strikes a terror into the Lion. The Elephant starts at the grunting of a Sow, and tho' the strongest of all Beasts, trembles when he hears that noise.

This Aversion in both these Creatures proceeds from such a Contexture of the Organs, as that the noises of the Cocks Crowing, and the Sows grunting, being conveyed to them, pierce their Bodies with a sort of Vellication, and as it were rend them a sunder with a kind of sharp smiting violence; insomuch that being received into their Ears, they open the Pores of the Brain, not only into the Muscles, that serve for the moving of the Members, but also into those Fibres of the Heart that conduce to the exciting of Fear. Who knows not that the grating noise of a Sow is very harsh and ungrateful to the Ear? In fine, therefore it is that a Lion trembles at the Crowing of a Cock; and an Elephant is affrighted at the Grunting of a Sow, because their Organs are so disposed, that they cannot receive in those sounds without great trouble and offence.

V.
How it
comes to
pass that
Elephants
cannot en-
dure the
sight of any
thing that
appears
Red.

To the same cause we may refer that which is related in the History of the Maccabees, namely that Elephants loaden with Wooden Towers full of Armed Men, at the sight of ruddy colour'd Grapes or Mulberries, were so exasperated thereby, that they could not forbear rushing into the midst of the Enemy, without regard either to their own or their Charges danger; and all upon this occasion, that Elephants have their Eyes so disposed as to be ill affected with Red, or any Colour inclining thereunto; and by certain Rays flowing

from such a Body, to have those passages of the Brain dilated, which open those Fibres of the Heart that conduce to the exciting of Rage and Fury.

A Camel and a Horse have great aversion to each other, so that these two Creatures can by no means be brought to live together without extraordinary dissention and hostility. The Weasel abhors the Toad, and comes not near it, but with great reluctance. The Mouse flies the Cat as its mortal Enemy. The Pheasant designs against the Hart, and to do him a mischief sits upon his Back, twitches up his Hair by the Roots and pecks his Flesh with its Bill.

The Peripateticks express all these Enmities and Aversions by no other name than that of Antipathy, thinking they have discharged themselves very well, and given a sufficient explication, when they tell us, that it is a certain natural hatred between one Animal and another, by which they fly and abhor each others sight. But who is there so ignorant as not to understand that we are not one jot the wiser by this Answer? That there is a dissention and hatred in several Creatures one with another; but how this enmity arises, or in what motives it is founded, certainly it can be no otherwise than from some passion transmitted into the Brain, through the external Senses by the help of the Nerves. For such is the disposition of the Brain, and such the contexture of the Fibres in Animals, that from such a species proceeding from without, such an affection must needs arise, no otherwise than as Heat hardens some Bodies, and softens and melts others. And hence it is that the smell of a Camel so disturbs the Brain of a Horse, that it renders him wholly unfit for service in the War. The evaporations only of Effluviiums from a Horse, hath such a power over an Elephant, as to drive it into a frantick rage, which effect can certainly be Imputed to nothing but such or such a disposition of the Organs, or contexture of the Fibres. And much after the same manner it is that a Blood-Colour disorders an Elephant: The smell of a Panther attracts Apes, and Fear seizes a Lion at the sight of a Cock.

Blood is said to gush out of a Wound, tho' bound up, upon the approach of the Person that gave it; and the Lawyers of some Countries take it for more than a half proof of Murder, when in the presence of any suspected, the Body of a slain Person begins to fall a bleeding afresh.

Lemnius in his 2d Book Of the Occult Miracles of Nature, assigns no other Cause to this Effect but Imagination only. So great, saith he, and powerful is the force of hidden Nature, and so strong is Imagination, that so long as any spark of Life is left, and the slain Body not quite cold, the Blood may possibly gush out afresh, and boil by means of the Cholers retained heat. Others refer it to the Antipathy that is between the Carcase and the Murderer, as if there were still remaining some struggling of the Spirits, somewhat like to that which struck the horror at the time of the Murder. But these Examples carry little weight with me who look upon the thing as dubious; and if I may take the boldness to contradict so many Assertors of this accident, altogether false: Forasmuch as I myself have seen the Dead Body bleed at the Nose and Mouth after three

VI.
The reason
of the A-
version be-
tween a Ca-
mel and
Horse, Cat
and Mouse.

VII.
Whether a
slain body
bleeds af-
resh at the
sight of the
Murderer.

three or four days, when the *Murderer* hath not been present, nay, not living. Besides, I presume there has scarce been any one heard of that could confidently attest upon *Oath* the truth of the thing, but rather relied upon the credit of Relaters or authority of Writers.

But let it be granted sometimes to happen, that in the presence of the *Murderer*, a *Murdered Body* may fall a *bleeding*; must therefore the Presence of the *Murderer* be immediately concluded from this accident of the *Bodies bleeding*, or at least a suspicion thereof be implied? Why may not the said accident of *bleeding* be rather imputed to Natural Causes, a thing indeed scarcely to be avoided, if all things which commonly happen about these *Dead Bodies* be well examined. The *Body* is carried into a Room where there is generally a great confluence of *Spectators*. By the breath then of so many *Men* the *Air* must needs be heated, and the *Blood*, tho' cold, be excited by this warmth, and consequently some small quantity of it may break forth out of the *Nose* or *Mouth*. From all which may be concluded how weak a testimony this *bleeding* is, and how slight those determinations are which *Judges* have made about the presence of the *Murderer*, unless we assert with *PLATO* that the *Souls* of Persons *murdered* persecute those by whom they have been deprived of *Life*.

*Thy Ghost ile ever haunt, where ere it is ;
Thy Soul, Bad Man, shall dearly pay for this.*
Virg. 4. Aeneid.

VIII.
Beasts have
an aversion
to the kill-
ers of their
Kind.

Beasts have a notable aversion to the Killers of their *Kind*, and to the utmost of their ability prosecute them: I have wondred, when being some time in the *Country*, I have observed all the *Swine*, and even the very *Pigs* of a certain *Village* grunting out their *Clamours* against one *Passenger* particularly more than others, and as it were preparing to set upon him; and asking the reason hereof, was told that this person was a *Butcher*, imploy'd in the killing of all the *Hogs* and *Pigs* of the said *Country Town*.

This *Aversion* of the *Swine* might very well be caused by the *smell* of the slain *Hogs*, or of some of the *blood* that stuck upon the *Butchers Cloaths*, which being corrupted and debased from its natural temperament, offended their *Sense*, and begat a certain horror in them. For it is not to be doubted but that the degeneration of any thing from its natural temperament, makes an ungrateful impression upon *Animals*, especially if it be from those of the same kind, and hurts and offends them much more than if it proceeded from those of a different kind.

IX.
Why some
Insects
have an
aversion to
Oil.

If the *Bodies* of certain *Insects*, especially of the *Silkworm*, *Grasshopper*, *Bee*, *Locust* or *Wasp* were so besmeared with *Hony* or *Oil*, that the black *specks*, running along their *Bodies*, were all covered, they would presently *die*, nor could they by any Art possibly be recalled to *Life*.

The Reason is, as *Malpighius* very well observes, because *Insects* have not only *Lungs* as other *Creatures*, but are so abounding with that sort of *Bowel*, that every Section of them is furnish'd with double *Lungs*: Nay, those *blackish Holes* are as it were so many gaps, which lead to

so many rough *Arteries* which convey the *Air* into the *Heart*, *Spinal Marrow* and other *Internal parts*; so that no wonder if upon the stopping up of their *Orifices*, the said *Insects* or little *Animals* perish and die for want of *respiration*.

CHAP. IX.

Of Sleep and Waking.

In *Infants* and *Children* soon fall asleep, and being in a sound Nap, sleep long and are not easily wakened.

I.
Why In-
fants are
most chiefly
addicted to
sleep.

Children are very much abounding with moisture, with the thickness whereof the *Pores* of the *Choroidal Contexture*, and the *Arteries* called *Carotides* are somewhat streightly closed and shut, and consequently afford not a very free passage to the *Animal Spirits*. For as we see sometimes the *Sails* of *Ships* slack and lank, when there blows but a gentle gale of *Wind*, not strong enough to stretch and expand them; so when there is not so great a plenty of *Animal Spirits* proceeding from the *Heart* as to fill the *Marrow* of the *Brain*, and to keep all its passages open, *Sleep* must needs arise. Since then in *Children* and *Infants*, *Humours* very much abound, the Motion of the *Animal Spirits* is by the resort of them to the *Brain*, much diminish'd, and the *Pores* of the *Brain* apt to be obstructed.

Hence it comes to pass, that they who have a more than ordinary *Cold* and *Moist Brain*, as persons of a decrepit Age generally have, soon fall a sleep. On the contrary, those that are of a more dry and hot temperament, pass many times whole *Nights* without sleep, and being vigorous and in the prime of their Age, are satisfied with a smaller portion of sleep than *Children* or old People.

II.
Who they
are that
soonest fall
asleep.

We *Sleep* sooner lying down than in any other posture, and sooner by a *Fire* than elsewhere.

That we sooner sleep lying than otherwise, is because our *Heart* is then parallel with the *Horizon*; whence it comes to pass, that the *Blood* proceeding from the sinister *Ventricle* of the *Heart*, passes to and fro with an equal force, which, when we stand or sit, it cannot do, for then the more subtle part of the *Blood* only ascends; so that in regard the grosser part is conveyed to the *Head* through the two *Carotides*, and the two *Vertebral Arteries*, consequently the fewer *Spirits* are from thence generated; the want whereof causes an inclination to *Sleep*. But that we sooner than ordinary sleep by the *Fire*, is because the *Pores* of our *Body* are much enlarged by the fiery particles, so that our *Body* becomes like a coarse *Sieve* or *Cullender*, by reason whereof the *Animal Spirits* take their flight the faster; thus the *Body* tired and debilitated, drops at last into a sweet sleep.

III.
Why we
fall sooner
asleep sit-
ting by a
Fire, than
in another
place.

It is vulgarly affirmed that the *smoking* of *Tobacco* both induces sleep and drives it away; and that it both excites and expels *Hunger* and *Thirst*.

IV.
How Tobac-
co taking,
both pro-
cures and
drives a-
way sleep.

The Reason is, because the *Animal Spirits* being stroak'd, and as it were led into a Dance by this sort of *Fume*, grow absolutely deaf to all troublesome accidents; nay, whatsoever of difficulty lies upon them to be done or suffered by them, they

they go through with ease and undisturbed: Wherefore to *Soldiers* and *Mariners* the use of *Tobacco* is a thing not only of advantage, but almost of necessity, forasmuch as it renders them undaunted and fearless, and ready to undergo all dangers, patient of *Hunger*, *Cold* and *Labour*; as gently railing and exalting, and as it were tickling the *Animal Spirits* to quick and expansive motions, and is a recreation to them, no less than the carousing of full *Glasses* of *Wine* to others.

V.
Poppy, Saffron, &c.
cause sleep.

Poppy, *Saffron*, *Mandrakes*, and the like stupetie, benumb and lay asleep those that take them.

The Reason seems to be, because *Plants* of this Nature are full of a very Uliginous or Clammy sort of *Juice*, with which the *Pores* of the *Chordal* *Contexture*, being stopped, are disabled from conveying to the *Brain* the *Spirits* proceeding from the *Heart*. For as some *Plants* are obstructive to the *Spleen*, others to the *Liver*, and hinder them from performing their usual office; so the *Poppy*, *Mandrake*, *Saffron*, &c. have a sensible power of obstructing the said *Contexture*, and causing fewer *Spirits* to be transmitted from the *Heart* to the *Brain*. For all *Somniferous* or sleeping things, whether outwardly applied, or taken inwardly, infuse a certain moistning all over the *Body*, and so induce a *Refrigeration* or *Cooling*, by which the abundance of *Spirits* is diminished, or their motion retarded. By the like Reason, those who are troubled with a *Catarrh* or *Rheum*, are apt to fall asleep, and to be oppressed with a kind of stupidity or heaviness, by reason of the abundance of *Humour* which lies about the *Fountains* of the *Nerves* and stops their passages.

VI.
Why Baths
excite to
sleep.

Balneo's generally cause sleep in those that use them.

This they do, not so much from the immediate virtue of *Bathing*, but so far as they communicate to the *Humours* circulating through the *Pores* certain sweet particles proceeding from those emollient *Herbs* infused in the *Bath*, whereby it comes to pass, that the *Blood* is somewhat restrained, and disturbed in its over-violent Career, so as that it drives not into the *Brain* with so much vehemence as before, nor is there so great a quantity of *Spirits* to be discerned, from the want whereof sleep arises.

VII.
How the
Lethargy
induces
sleep.

Certain *Diseases*, as the *Lethargy* and others, create in the Patient an excessive drowsiness, and at length plunge him into a deep sleep.

And this by reason that the proximate cause of this affection is the obstruction of the *Pores* of the *Brain*, proceeding from a gross *Humour*, and the want of *Animal Spirits* immerst in the overflowing stagnation of *Humour*, by which means those affected with this *Distemper*, must needs be apt to fall asleep. And such a sleep it is, that it may be accounted not only the Chain and Fetter of all the exterior *Senses*, but also the Oblivion of all things. Wherefore those that have taken in the *Infection* of the *Plague*, if they are of a sleepy Constitution, and give themselves up to repose, become the more deeply infected, and Nature is the less able to resist the *Contagion*. Moreover, those that have drunk *Poisoned Potions*, if upon the drinking of them they are overtaken with sleep, they suffer in a higher degree, and the *Poison* the sooner reaches their *Vitals*. Because too much

evaporation oppresses the *Natural Faculties* and renders them dull, heavy and incapable of overcoming the *Evil*.

The wakeful *Cock* certainly shakes off Sleep about *Midnight*; Whence MANTUAN,

VIII.
Why the
Cock wakes
at Mid-
night.

The Bird that's sacred to the Sun's bright Ray,
Bids Night adieu, salutes th' approaching day.

Cicero in his 2d Book of *Divination* judges *DEMOCRITUS* to have most excellently explain'd the reason why *Cocks* Crow before Day, as follows, The Meat being gone off from the *Stomach*, and disper'd into the whole *Body*, the *Cock*, saith he, in the silence of the Night, having digested his Meat, and being satisfied with rest, to express his content, lifts up his *Crowing Voice*, and displays his *Gay Wings*. But with this opinion of *Democritus* I am no way satisfied. Because if the *Cock* rowles from sleep, and Crows after *Midnight*, by reason of the digestion of his Meat, it should follow from thence, that afterwards he would no more indulge to rest; but this Experience contradicts. Besides, he Crows as well at Noon, being full, as also after treading of the *Hen*; so that this Reason might better be given, namely, that the *Sun* having past the *Nights Meridian*, and now steering towards the *Morning*, agitates and drives before him a cold *Nocturnal Gale*, by the shuddering approach whereof the *Cock* being roused out of his sleep, flutters with his *Wings* and sets a *Crowing*.

Or why may we not affirm, that certain times are allotted to all *Creatures* for sleep, and this particularly to the *Cock*, at which by an innate motion it wakes, and having its *Spirits* in agitation, sets a *Crowing*, and by his *Crowing* testifies his wakefulness? For why may not the *Spirits* of the *Cock*, as well as of a *Goose*, or any other Bird of that Nature, inclosed in the *Brain*, excited either by its own abundance, or by some external murmuring noise, so open those passages in which the said *Spirits* use to have their course from the *Brain* to the proper *Organs* of the *Senses*, as from the Center to the Circumference, as by a concurrence made to move the *Nerves* attendant to the fore said motions?

Soon after Dinner or Supper we are more apt to fall asleep than at other times. Whence many have taken up a custom of setting themselves to sleep after Meat, to which Custom Nature seems to invite, and few can put it off without much reluctance.

IX.
Why we
are most
apt to be
sleepy after
Meals.

The Reason is to be derived from the very concoction of the *Meats*; for when at that time a cruder *Chyle* from the *Stomach* and the *Intestines* is mingled with the *Blood*, and hinders the rarefaction thereof, it must needs follow that the *Brain*, by the loss of *Spirits*, is refrigerated at that time, and so contracts a certain sleepy disposition, so that the *Spirits* which remain are scarce sufficient to keep the passages of the *Nerves* open and tite: Hence we find by experience, that the external parts of the *Body* are after Meat refrigerated, so that the Head hangs down, and the *Eyebrows* fall, if we do not rouse and set upon some serious affair, and find work for the *Animal Spirits*.

Sleep

X.
How it
comes that
we are more
apt to wake
out of our
Sleep by
Night than
by day.

Sleep is not so easily broke off by Day as by Night; as we find by experience in the Spring and Summer, in which, by reason of the Suns light coming in at the Chamber Window, we are more difficultly rous'd from Sleep than in the Winter when the Sun is at a distance, and we are surrounded with Mist and Darknes.

This proceeds not from Light, as from the efficient Cause; as if Light were indued with a faculty of procuring Sleep; but only by accident, forasmuch as our Eyes, being weak, and smitten with sudden cold, are apt to wink, and at last to close and be quite shut: For when we open our Eyes, the Light comes upon them, and smites them, and they not knowing how to fend back the Rays, are offended and disturbed to be so smitten by them, shut down the Eye-lids again, and betake themselves immediately to a renovation of Sleep and Repose. Hence it comes to pass that waking at broad day, and opening our Eyes, we feel a kind of force and pain in so doing; in regard the Light smites not the Retine Tunicle by degrees, but all on a sudden.

XI.
Why the
extream
parts of our
Body are
apt to be
cold in Sleep
than when
we are
awake.

When we are asleep, we are more apt than at other times to be cold in the extreme parts of our Body, but hot within.

This most probably proceeds from hence, namely, for that the Blood not being at that time agitated by any passion, or any violent exercise, flows so quietly that it hath not force enough to convey any heat to the extremities of the Body, whence they become cold, at least in those persons whose Lungs are in a good temper: But for those that are troubled with bad humours, or are Asthmatick, they cannot indure to lie covered, by reason that the heat which they bring upon themselves by being covered, very much augments their inward heat.

XII.
Why those
that lie ill
at ease, are
easily
wakened.

Those that lie not at ease, by reason of the Sheets not lying smooth under them, or the hardness of the Bed, or a necessity of making Water; are very often interrupted in their Sleep, and forc'd to lie awake a long time.

The Reason is, because the Animal Spirits which are bred during Sleep, and continually repair'd by the motion of the Blood through the Heart, can have such a plentiful confluence, as that having thereby the power of opening the Orifices of the Nerves, they fill them in such a manner as is necessary to extricate their Filaments, and give occasion to the Soul to perceive those Objects: For whatsoever gives disturbance to any sense, and interrupts the usual rate of motion, is an absolute Enemy to all Repose.

XIII.
Why at-
tentive
reading af-
ter Meals,
induces
Sleep.

We find by experience, that when we are very attentive in Reading or Studying presently after Dinner or Supper, we are apt to fall asleep, but not in the least when we are present at the acting of a Comedy, or the sight of any thing that moves to Laughter.

The Reason is, because any studious attention, or serious exercise of Mind, draws the Blood more copiously toward the Head, and gathers it together from all parts of the Body towards the very midst of the Brain. By which means it comes to pass, that upon the Blood penetrating the Brain there follows a great recourse of Nervous Juice that way, by which the Spirits are presently obstructed, and their intermediate places taken; but it falls out otherwise, when after Dinner we repair to a

Comedie, because then the Animal Spirits being diffused with pleasure, distend and enlarge the Brain; so as that the passages being streightned by that inflation, stop the course of the Soporiferous Humour, and hinders it from forcing into the Brain.

Coffee is said very much to keep away sleep, and procures an extraordinary disposition to wakefulness, and an unwearied exercise of the Animal Faculty; forasmuch as upon the drinking of this Liqueur any one may sit late at night for the carrying on of any Studious Contemplative or Wakeful business.

This effect in my Judgment may very well be imputed to those adust particles of the Coffee, which mingling first with the Blood, then with the Nervous Juice, keep by their agility and restlessness the pores of the Brain open, and the Spirits having now shaken off all Curb or Bridle, are prick'd as it were with Goads and Stimulations to the longer and more continued performance of their Offices. In like manner the Cause of a very wakeful temper may be imputed to a torrid and Melancholick Blood which supplies the exterior Brain with such a sort of Nervous Juice as is parch'd and fill'd with adust particles, and is neither fit to remain longer within the pores of the Brain, nor kindly to receive and contain the Animal Spirits.

This kind of Drink, tho' of very common use, and in some cases very wholesom and medicinable, yet at other times, and in other cases it may be hurtful and unwholesom; and this not only Reason, but also common Observation tells us; forasmuch as excessive drinkers of Coffee are very often Lean and Paralytick, and many times unapt for Generation: In regard, since the Blood, by the frequent and excessive use thereof, becomes in a great measure acid and adust, it is consequently the less apt and capable to nourish.

In Children Sleep is procur'd by the motion of Libration, so called, or rocking in a Cradle.

The Reason is, because this rocking to and again stirs the Humours of the Brain; by the access of which Humours to the Brain and Origin of the Nerves, Obstructions are created: As when any sort of Liqueur is injected with a force upon whatsoever Object is capable to receive it, it sinks in the deeper, especially if the Body into which it enters be tender and soft, as the Brain of Children most certainly is.

Some wake constantly at set hours.

This comes to pass, partly by reason of daily custom, and partly because at certain set hours those men have sufficient plenty of Animal Spirits to puff up the Tubes of the Nerves, and also the Muscles; as appears in those that are more hungry at some times than others: Of which there can be no other reason given, than because by that set time the Blood has made several circulations through the Heart, and by that means hath obtained such a due degree of acidity, as is requisite for the exciting of Hunger in the Stomach.

As for the time allotted for Sleep. That which the Schola Salernitana hath decreed in this point, is most generally received.

Seven hours in Sleep the Eyes to hold,
Is long enough for Young and Old.

7 N

But

XIV.
How Coffee
happens to
drive away
sleep.

XV.
In what
the excess
of Coffee is
hurtful.

XVI.
How it is
that Chil-
dren are
rock'd a-
sleep by the
motion of
Libration.

XVII.
How some
duly come
to wake at
set hours.

XVIII.
How many
hours are
to be allot-
ted for
sleep.

But in this matter a certain set time cannot be appointed to all alike, but rather the different *temperament* of this or that *person* is to be consulted. For to those whose *Blood* is more thin and subtil, as the *Spaniards*, *Italians* and *French*, a shorter time of *Sleep* is sufficient; for example, the space of five *hours* or thereabout, which would be too short for those that have their *Blood* more gross and viscous, for such *Blood* should be allowed time to pass often through the *Heart* before it can be made thin enough to afford matter for the generating of *Spirits*.

CHAP. X.

Of the Diseases, and Death of Animals.

I.
What the
Cause of
Diseases is
in Animals.

THERE are no *Creatures* whatsoever totally exempted from *Diseases*, but according to their different temperament are affected with some or other *Bodily Distempers*. Some are troubled with a Shaking or Trembling of their *Limbs*; others are in a manner choak'd up with an Inflammation of the *Jaws*, commonly called a *Quinsie*; others are afflicted with the rising of the *Lights*, &c.

The Reason is plain, because *Sanity* or *Health* is a certain disposition of the *Body*, by which it is rendred capable to perform its Offices. So that when-ever the temperaments of the parts chance to be altered, or its *Organs* to be intercepted, the Order or Course of Nature being hereby inverted, the *Creature* must needs be deprived of *Health*, as falling from its primitive State of *Body*. So the tremour or shaking of the *Limbs* proceeds from a debility of the *Nerves*, or some depraved affection which haply some foregoing *Convulsion* had left behind it; or by reason of some *frigid Humour*, which insinuating through the hidden passages, impells the *Members* to this motion. So the *Quinsie* in such sort streightens and shuts up the *Jaws* of some persons, that they are hardly able to breath, much less to swallow any thing, by reason the *Inflammation* or malignant Humour so wholly takes possession of the *Nerves*, that they are rendred in a manner incapable of motion, and scarce sufficient for the opening of the *Jaws*: So the rising of the *Lights* is incident to those whose *Stomach* is obstructed by certain humours. For since the *Blood* is strained through the *Liver*, it may very well so happen, that that which is transmitted from the *Milt* through the *Splenick Vessel*, or flows from the *Mesentery* is corrupted and shuts up the pores through which it is to pass. In like manner we may inquire into the reason of any other *Disease* which is incident to *Animals*, ever perverting or disturbing their actions, and hindring their faculties from performing freely the offices of *Life*.

II.
Whence it
is that the
pain of the
Teeth is so
sharp and
vehement.

The pain of the *Teeth* is a most acute and sensible pain.

It is not to be imagined, that the *Teeth* have any sense of pain, since they are all Bone and solid: But this pain vulgarly ascribed to the *Teeth*, proceeds from those *Nerves* which terminate at their Roots, and the pain is the greater, First, because those *Nerves* being of a very short extent, so much the sooner transmit the impress motion to the common sensorium. 2dly, Because they hap-

pen to be overmuch stretcht, whereupon that action of the *Internal Object* is the more lively propagated. As we may observe in *Musical Chords*, that those which are stretcht to the highest pitch, give the acutest or highest sound. 3dly, Because they go right forward without any deviation, by which means the impress motion is carried the more easily to the inmost parts of the *Brain*, as appears in the difference between a *Rope* drawn out into a strait *Line*, and another laid crooked or winding. But this most acute pain of the *Teeth* usually ceases upon drawing out of the *Tooth*, in regard by this means the over-much tension of the *Nerves* is remov'd, by reason whereof the impress motion cannot continue to be transmitted so vivaciously to the sensorie.

Hereupon it is that *Infants* die through the excessive pain of *Teeth*, which when they begin to breed, they by the violence of their crying so excessively shake the *Brain*, and the *Membrans* covering it, which are very soft and tender, that all the natural faculties of the *Infant* are exceedingly disturbed and out of order, whereupon the *Milk* and *Blood* become corrupt, and the *Spirits* bred of them, contract an acrimony, which entering into the *Nerves* through the *Muscles* excite them more than ordinary, and cause *Convulsive Fits*, of which they oft die, because the efforts they make, cause the blood to flow in such abundance into the cavities of the *Heart*, that they become too inflame, and cannot give it a free course, and continue that circulation which is necessary for *Life*.

The *Small Pox* and *Measels* are incident to all persons, and most especially when they are *Children*, but if not then, yet at least at some time or other of their *Life*.

This is because they brought into the world some impure particles which lie skulking here and there in some lurking places of the solid parts, and which in process of time are drawn forth from thence by a ferment or peculiar matter of the first *Element* introduc'd by fermentations, and are pour'd upon the mass of blood in which they excite a violent motion, until at length they are cast out through the pores, and appear upon the superficies like little small Vesicles or Bladders. Those that have but few feculencies stagnating in the *Body*, are for the most part but lightly invested with them; those that have none of these feculencies, are never troubled with this *Distemper* during their whole *Life*, but there are very few that escape. Those that once have them very much, seldom have them again, which is a great sign that the place which gave harbour to the Peccant Matter, is totally clear'd and empty'd thereof. But those who, who having in their *Bodies* a plentiful stock of this said matter, yet have put forth but few, are in much danger of being infected with them a second time, if not a third. These *Distempers* are epidemical, and sweep away yearly, especially out of all great *Towns* and *Cities*.

Many feel great pains returning yearly at some set time, especially such as proceed from old *Wounds*, or some acute *Distempers*, which, tho' cured, yet leave a remembrance behind them.

The Reason seems to be this, because in the scars which those *Wounds* have left, the pores are very much altered,

III.
Why some
Infants die
with breaking
Teeth.

IV.
Why the
Small Pox
and Measels
are so common.

V.
Whence it
happens
that some
feel greater
pains at
one time
than another.

altered, both as to their *Magnitude* and *Figure*, and wholly different from the *pores* of the rest of the *Body*. When therefore any change of *Air* or *Season* is at hand, another *Aether* usually approaches our *Earth* than before, which rushing into the *pores* of our *Body*, easily passes them all, those only excepted which are in the *Scar* of the *Wound*, in regard they have a perfectly different *Figure* from any of the rest; whereupon the said *Aether* must needs make a more forcible entrance into the intorted *pores* of the *Scar*, and consequently excite a *Vellication* and *Sense of Pain*.

VI. The *Distemper*, commonly called the *French Disease*, had its beginning among the *French* at the *siege* of *Naples*, being till then unknown to all but the *Canibals* of *India*.

The Cause of this so foul and poisonous a *Mur-rain*, the *French* ascribe to certain *Mariners*, who coming from *Mauritania* to the said *Siege* to vend their *Merchandise*, sold instead of the *Sea Hogs* the *Flesh* of *Men* newly killed, salted and barreled up. Which sort of *Meat* the *Soldiers* feeding very much on, contracted this *Disease*, which afterwards spread very much by *Contagion*, and infected those *Women* with whom they had to do. Nor is this Reason of the *French* any way dissonant from truth, since certain it is that the *Canibals* who feed upon *Mens Flesh*, are greatly punished with this *Disease*. And *History* testifies, that the *Indians*, when first discovered, were known to have this *Venereal Distemper* frequently among them. Because the *Eating of Human Flesh* begets foul and fulsome *Vapours*, by which the *Head* being wrought upon is *Vitiated*, and the contexture of the *Fibres* of the *Brain* corrupted.

VII. Persons in a *Fever* are wont to lie all night as if they were sound asleep, when in the mean time they have not one minutes rest, but lie muttering to themselves, and in a very restless condition.

The Cause is to be sought from the *pores* or *tracts* in the *Brain*, by which the *Animal Spirits* are conveyed to the *Brain*, which are very much obstructed by a certain gross matter which proceeds from the *mass* of *Blood*, in regard the *Spirits* being at that time not allowed their wonted dilatation, a heaviness to *Sleep* seems just falling upon them; but by reason of certain acid or aculeated *Corpuscles* adhering to the said *Spirits* which put them into motion, it happens that some of them break the way, tho' barricadoed or shut up, and stumble upon each other by an oblique course. Whereupon so great an agitation of them, tho' confused, by reason of the divaricated obstacles, cannot but disturb the quiet and cessation of the *Animal Function*.

VIII. In a *Palsie* the parts being loosened, pine away, and by little and little consume, till at last scarce any thing is left but *Skin* and *Bone*; altho' the *Blood* at the same time have a free and plentiful course, and circulates after its wonted manner through the whole *Body*.

The Reason hereof must be supposed to be, for that in this *Disease* the *Nerves* are ill-affected, and cannot perform their office, for the *Blood* is not, as some of the *Ancients* believed, an adequate nourishment of the parts of the *Body*, but a certain *Juice* transfused to them from the *Brain*, and the *Medulla Spinalis*, by the mediation of the *Nerves*.

So that since in *Paralyticks* or those troubled with the *Palsie*, the *Nerves* are obstructed, and can no longer supply nourishment; no wonder if in that *Disease* the parts of the *Body* dry and wither, and the fleshy substance falls away. Hence it comes to pass, that those who have *spongy* and *moist pores*, by reason of their reception of their greater plenty of *Alimentary Juice*, grow fat: But those on the other side are apt to be lean who abound with *Blood*; yet by reason of overmuch heat, have their passages straight, and their *Nerves* not wide enough for the drawing in of *Juice*.

The *Elephantiasis*, or vulgar *Leprosie*, as also that which is called *Stomacacae* and *Scelotyrbe*, are now much more mild and gentle than in former Ages, in which persons were wonderfully tormented and felt intolerable pains.

The Reason is, either because the rigor of the *Distemper* is much taken off by powerful *Medicaments* now better known than formerly, or because Nature accustomed to those *Distempers*, hath induc'd such a *Callosity*, that they seem now more tolerable than of old, and so much the more tolerable by how much they have been the longer indured. The Reason whereof may possibly be, because the *Ardour* and *Ebullition* of the *Distemper* is diminish'd. Or else Nature accustomed to a pain of so long continuance, ceases any longer to struggle so much with it, as being now familiar, and as it were domestick: Or Lastly, Being nourished even by those corrupt *humours* is the less offended by them. For even as those nasty sorts of *Fellows* that empty *Houses* of *Office*, and cleanse *Sinks* and *Common Sewers*, are made by long custom unsensible of the filthy *smell*: So those that are diseased, for examples sake with the *French Pox*, after they are used to it, as if they had lost their *Sense*, are no longer sensible of the defects of the *Body*, and debilities of *Nature*; by reason that *Nature* and the *Disease* grow at last to be of a party and agree together, and the *Humours* of the one are mixt with the *Humours* of the other.

When *Night* comes, pains increase, and are exasperated to a greater height.

The Reason is, for that the *Humours*, quiet before under covertures and bindings, are mov'd and stir'd up, so that those *Acid Particles* formerly imprisoned, take thenceforth an occasion to *Vellicate*, more than before the *Nervous Fibrils* of those parts in which they are fixt. Whence there must necessarily follow a notable aggravation of pain; as appears in those who are distempred with the *Venereal Disease*.

Some *Fevers* (or rather *Agues*, for so they are commonly called in *English*) begin with cold, in such sort, that not only the extreame-parts of the *Body* are seized with cold, but with a certain kind of *Action* of *Horror*, the whole *Body* trembles and shakes.

The Reason is, because *Fevers* proceed from a certain *Humour* falling into the *Mesentery*, or some other part of the *Body*, which *Humour* flowing through the *Veins*, and by that means mixing it self with the *Blood*, is at length conveyed therewith, to the *Heart*, which gives an obstacle to the *Blood* from being heated there, and dilated as before, and conveys that heat which it borrows from the *Heart* to other parts of the *Body*. Whereupon

IX. How some Diseases come to be more tolerable than in former times.

X. Why Pain increases at Night.

XI. Why some sort of Fevers begin with Cold.

a certain tremour must needs arise; and the *Febricitant* or *Fever-seised* Persons be taken with a sudden *shaking* of the *Members*: Which yet never happens, but at the beginning of a *Fit*. For as *Green Wood* thrown upon a *Fire* puts it out, or at least opposes, and resists its *heat*, but being once kindled, sends forth a fiercer flame than any other *Wood*: So after that the said *Vitiated Humour* hath been for some time mixt with the *Blood*, it grows hot at length, and is dilated in the *Heart* more than the *Blood* it self. And this causes the return of the *Fit*, which lasts so long, till the said corrupted matter is exhaled and reduced to the natural constitution of the *Blood*.

XII.
Whence the
diversity of
Fever
arises.

Fevers, which are so very incident to *Mankind*, afflict not the *Body* always after the same manner: For some affect with a continual burning or violent heat; others *intermit*; some return more suddenly, some more leisurely, and some anticipate and come before their usual time.

The difference of all these *Fevers*, arises from the *Morbifick Matter* which creates the *Fit*. For tho' that *Matter* in the former *Fit* hath been all purg'd away, yet there still remains some fewel or depraved disposition in that place wherein the *Humour* was first vitiated. Whence it comes to pass, that that which succeeds there anew, is first coagulated, then corrupted, and after some certain time growing to maturity, flows toward the *Heart*, in the same manner as the former, and creates the same symptoms. Whereupon, if the *Morbifick Humour* which succeeds into the same place wherein the former was corrupted, wants the maturation of three days, before it mix with the *Blood*, it produces a *Quartan Fever* or *Ague*; if it stand in need of two only, a *Tertian*: But when the said matter applies to the *Heart* with a continual onset, and vellicates or twitches it without ceasing, it induces a *Quotidian*, or continual distemper. Lastly, If the *Blood* be so vitiated, that between the time wherein the last drop of the depraved *Humour* flowed out, and that wherein the first drop of the new gathered *Humour* began to take its course, it cannot be purified, the *Fever* renews with a more ardent inflammation than ever.

XIII.
How a Fe-
ver arises
sometimes
from Pain.

Besides all these several kinds of *Fevers*, *Physicians* observe that a *Fever* sometimes proceeds merely from a previous pain.

The Reason of all this we shall soon understand, when we consider that pain hence arises, namely, for that the *Fibres* of the *Parts* incur danger of Ruption or breaking, if not Ruption it self. Whence sensation of pain arises in the *Mind*, which is followed by an immoderate influx of the *Spirits* into all the *Nervous Tribe*; since therefore many little Branches of the *Nerves* are implanted into the *Arteries*, and feel the said inordinate influx of *Spirits*; hence it comes to pass, that the *Arteries* are hurtfully smitten and battered, and that the *Blood* contained in them is wonderfully streightned and pent in, and its mixture confounded and disturbed. And hence it is that the *Fever* arises.

XIV.
Why after
the fit of a
Fever the
whole Body
is in pain.

After a fit of the *Fever* we feel a pain all over the *Body*.

Because since the *Feverish Heat* which uses to succeed the shakings and cold fit, depends merely upon this, namely, that the *Blood* by means of

this admixture of the *Febrile Matter*, rises into a preternatural and vehement heat and ebullition, as moist and green Sticks of Wood laid upon a *Fire*, do not very easily catch, and burn into a blaze, but when they have once taken, cast a most ardent heat above all the rest of the fewel: Hence it is that by this great effervescence of *Blood* within the *Heart*, the particles thereof are more subtiliz'd, and as if abundance of *Salt* were mixt with it, the said *Blood* makes an irruption into the *Fibres* of the solid parts, and by corroding them, creates that pain which so afflicts us after the *Fit*.

The like dissertation we may make concerning the periodical accessions of the *Head-ach*, which are daily, by reason of the *Morbifick Matter* rising and boiling up to a heighth at a set time. But so far varying as to be either before or after *Meat*, according as the offices of *Digestion* and *Distribution* of the *Aliments* are sooner or later performed.

Those that are sick of a *Fever*, and oppress with an excessive and unwonted Heat, *Leanness* and *Consumption* attend them.

The Reason is, because the particles of the *Blood*, or *Nutritious Juice* which are for the nourishment of the *Body*, and ought to make some stay in the *Members*, to which they take their course, are more hastily moved and agitated, than to be able to make their due stay, and afford their due nourishment, but either are thrown off by those *Members* in a nature of *Sweat*, or pass away by insensible *Transpiration*; whence the *Body* must needs be exhausted and become thin and lean for want of nourishment: Just as *Plants* are dried up and wither, when by the overmuch heat of the *Sun*, the *Juice* assigned for their nourishment is too quickly strained within their pores, and without making that stay there which is required, passes away and drops off.

Some there are that pretend to know all *Diseases* by *Urines*, as commonly your *Quacks* and *Mountibanks*, and some reputed *Physicians* are not ashamed to undertake the same thing; nay they go so far as to make us believe, that they can tell the *Diseases* of each part of the *Body* by the *Urin*, and whether it be the water of a *Young Man* or an *Old*, of a *Man* or a *Woman*, of a *Woman* with *Child*, or not with *Child*. But these things I look upon as trifles, for how can it be resolved from the *Urin*, whether the *Eye* akes, or the *Nose*, or the *Ear*? Whence the *Head-ach* arises? Whether there lie any obstructions there undiscovered? whether there be any *Distemper* in the *Arms*; whence its pain comes? For that all these things are impossible, both Reason and Experience testify. I confess indeed that something may be conjectured from *Urines*, but it can be nothing but what is very general. So if *Matter* be voided together with the *Urin*, we may conclude that there is some part *Ulcerated*, but what part that is, who can resolve? For we see that *Matter* is voided when the *Lungs* or *Bowels* are *Ulcerated*; and tho' the *Urin* passes through these *Ultimate Parts*; yet it is a difficult thing to resolve whether it proceeds from the *Reins* or from the *Bladder*. This is certainly found by experience, that *Physicians* are very often deceived in this matter. Our judgment therefore of *Diseases*, especially of those parts

XV.
The Head-
ach hath
also its ac-
cesses at a
certain
time.

XVI.
Why sick
persons
grow lean.

XVII.
Whether
Diseases can
be known
by the Urin.

parts through which the *Urin* passes not, ought not to rely upon the inspection of the *Urin* only, but upon the indications that are to be gathered from complaints of the *Sick*.

XVIII.
Whence
Deliriums
arise in
Acute Dis-
eases.

Acute Diseases are frequently attended with those unsettlements of *Mind*, with which *sick people* are mightily subject to be molested, and by which they are hurried into divers hurtful and unquiet thoughts.

The occasion of this is, because the *Animal Spirits*, which by chance, and without any design wander in the *Brain*, are carried by their own proper motions to open certain *pores* thereof, in the same manner as they were formerly opened at the presence of some *Objects*; whereby it comes to pass, that those *Objects* are perceived under the same *Images*, as if they were really present, and so affect the *Soul* residing in the *Brain*, as if it were smitten by their *Species*.

So *Drunken Men* are affected with a kind of *Delirium*, while the *Spirituos Particles* of the *Wine* or *Beer* boiling by the heat of their *Stomach*, passes the *pores* of the *Brain*, and the *Spirits* residing therein take away the poise of the common *Sensorium*, which nevertheless was required; if a right determination of the *Animal Spirits* had been made by the *Soul*. But since the *Soul* is incapable of governing all these *Spirits*, hence it comes to pass, that they flutter up and down without any order, and without any determination of *Mind*, fall sometimes upon these, sometimes upon those *pores*, which occasions all those antick postures, as *Dancings*; loud *Laughters*, idle *Songs*, &c. which are commonly taken notice of in *Drun-kards*, which actions last so long, till at length, the choicer part of the *Spirits* being dispersed, the common *Sensorium* hath its *Equilibrium* or Poise

restored it, so that the *Mind* can at pleasure dispose of the *Spirits* through the whole Body.

Thus the *Blood* effluating in *Fevers*, causes either a simple *Phrensie*, whether the *Blood* it self takes fire, or carries along with it into the *Brain*, certain strange and unruly corpuscles, which enter the passages of the *Brain*, exagitate the *Spirits*, and either drive them into confusion, or utterly overwhelm them, as commonly happens in *Drun-kards*. Especially if the *Brain* be weak and loose, and the bilious *Blood* be turgid and swell with copious *sulphur*. Neither are there wanting *saline* and *piercing Particles*, which enter the *pores* of the *Brain*.

XIX.
How a Fe-
ver causes
a Delirium
in many
People.

Animals living spontaneously, freely and without any force upon them, are however at length taken away by *Death*. Because the *Fermentations* in them grow daily weaker and weaker; hence first results a *gross Chyle*, a viscous and earthy *Blood*, and consequently less moveable, and which introduces various obstructions in the *Capillary Vessels*. For as age comes on, the said *Fermentations* are more and more diminish'd, and almost totally extinguish'd, whence there must needs arise a sort of *Blood* yet much more *Earthy*, and scarce moveable out of its place. The *Fibres* and *Pores* of the parts are streightned and grow stiff, and still less and less admit of, and take in *nourishment*. Hereupon follow *Universal Obstructions*, and by degrees all parts of the Body grow lean and waste away, till at length the very snuff of *Old Age* brings along with it *death*, or a total dissolution of the *Auto-matick Conjunction* in *Brute Animals*, but in *Man-kind* a separation of the *Soul* from the *Body*: For there is nothing so natural as that every thing should be dissolved in a retrograde order and manner to that wherein it was formed into a composition and subsistence.

XX.
How dis-
ease comes
at length
to die.

The Ninth Part

OF THE

HISTORY

OF

NATURE.

OF

MAN.

CHAP. I.

Of the Sense of Touching, or Feeling.

I.
The Skin
partakes
more of the
Sense of
Touching,
than all
other parts
of the Body.

ALTHO' the Sense of *Touching* is spread all over the Body of *Man*, yet it is generally allowed that the *Skin* partakes more of this *Sense* than all the other parts, and the reason is, because the *Nervous Fibres* which are spread almost through all parts of the *Body*, run through the *Skin* in a particular manner, and in effect, the whole construction thereof is particular: For besides, that it is form'd of *Nervous Fibres* which are interwoven one with another, there spring from among these *Fibres*, certain small threads dispos'd into the form of *Pyramids*, and are *Nervous Eminences*, covered with a *Cuticle* or *Upper Skin*, under which is discover'd an *Oily Humour*, which keeps them always very supple. Whence it must needs follow, that the immediate *Organ* of *Touch* is no other than the *Nervous Fibres* extended all over through the *Skin*.

But this *Sense* of *Touching* or *Feeling* is chiefly predominant in the *hand*, as *MALPIGHIIUS* confirms, who observed by a *Microscope*, that in the hollow of the *hand*, and the extremities of the *Fingers*, there were certain elevated wrinkles spirally drawn, in which were hidden those *Nervous Bodies* that serve for the act of *Touching*.

II.
Of a Wo-
man, who
after she
cutting off
of her Leg,
complained
of great
pains she
felt.

A Certain *Noble Woman* in *Dauphiny* had one of her *Legs*, newly affected with a *Gangreen*, cut off, but with such *Art* and *Industry*, that she had not the least suspicion thereof, being deceived by a *Wooden Leg* which the *Surgeons* brought along with them, wrapt up in a *Cloth*; but some considerable time after the amputation, she complained of very sharp prickings and shootings, not only in her *Leg*, but down to her very *Toes* ends. Nor did she cease complaining after the matter discover'd, but still asserted that she felt pain in her *Leg*.

The cause hereof can be no other than this, namely, that such is the constitution of our *Body*,

that no part thereof can in the least be stirred by any other remote part, but it may also after the same manner be moved by intermediate parts, altho' the remoter conduce not at all to the motion: For who ever draws the last part of the given *Rope* *A B C D*, the first part *A*, will be moved in the same manner as it might be moved if it were drawn by one of the intermediates *B* or *C*, the last part *D* remaining unmoved; so when the *Noble Woman* felt the pain of the *Joints* of her *Leg* and *Foot*, the reason hereof was, because the *Nerves* which first descended to the *Foot* from the *Brain*, and were then terminated in the *Thigh* near the *Knee*, were there moved in the same manner as they were to have been moved before in the *Foot*, upon the sense of this or that *Toe* aking to be imprest upon the *Soul* residing in the *Brain*: Hence an Argument may be brought against the *Aristotelians*, who will have the *Soul* to be actually present in each part of the *Body*; for were it so, how could the *Soul* of this Lady judge her pain to be in her *Leg*, which was cut off, or in her *Toes*, when it was indeed in her surviving *Thigh*?

Thus it happens in us many times that when we lean longer than ordinary upon our *Elbow*, we feel a numbness in the *Little Finger*, so that the *Nerve* which is deduc'd from the *Brain* to that *Finger* being compress'd more than it can indure, moves the common *Sensorium* with the like affection, as if it were prest in the said *Finger*.

When any one, on a suddain, and having his *Mind* intent upon other things, is touch'd by any one, he is seised by a suddain trembling or horror.

The cause seems to be, upon an apprehension that by the said suddain stroke some mischief is design'd against him, whereupon he recollects himself, and endeavours to decline it. For then the *Animal Spirits* are suddainly stirred up, and tend in greater plenty to the *Brain* than that they can possibly be derived thence in order into the *Muscles*. For that which comes to the *Soul* by the *Senses*, affects it more, than that which is represented

III.
How the
Sense of
Touching
may be de-
ceived.

IV.
Why any
one touch'd
on a suddain,
feels a horror
upon him.

sented to it by reason, tho' for the most part it comes short in truth and reality: Whence in regard by that unexpected *contact*, there is but a slight impression made in the Body, and he finds the mischief which he apprehended coming upon him, to be nothing but a vain apprehension, he returns immediately to himself, and after a little time lays aside all horror.

V.
Why they who tickle themselves, are not touch'd with horror.

Hence it comes to pass, that when we *touch* or tickle our selves with our own hand, we are not so shaken or smitten with *horror*, because therein is no surprise, but we act at pleasure, and consequently following our own way and method, we are not touch'd with that apprehension of *evil*, which is the principal cause of the said *Horror*.

VI.
Why Titillation is chiefly rais'd in the Soles of the Feet.

Titillation is chiefly rais'd in the *Soles* of the *Feet*, which delighting the Patient by a grateful *Prurieny* or *Itching* affects him with a sensibility of *Pleasure*.

Titillation is produc'd when the *Nerves* terminating in the *Skin* of the whole *Body*, are agitated more vehemently than ordinary. Yet so as that there follows thence nothing of *hurt*; or when the *Filaments* which are carried from the *Brain* to the other remoter parts of the *Body*, are drawn with the like force, so as they be not broken, nor divided from the *Members* to which they adhere; which *Titillation* or *Itching* is chiefly perceived in the *Soles* of the *Feet*, by reason of the tension of the *Skin* which is impell'd by a light contact, and transmits motion to the *Nerves*, the *Organs* of the *Senses*: Or else, when through the unwontedness of the way of promoting the agitation of the *Spirits*, new force accreus to them. So a *Feather* or *Bulrush* lightly running over the *Lips* or *Cheeks*, causes a *titillation* there, by reason of the thinness of the *Skin*, and the seldomness of any contact hapning in those parts: Whereas if things harder than those aforesaid are applied, or the parts are more frequently touch'd the *Titillation* ceases; nor are those parts affected in any unwonted manner. But the pleasure which proceeds from *Titillation* hence arises, viz. because the *Objects* excite a certain motion in the *Nerves* which might possibly hurt them, unless they had strength enough to resist it; or unless that *Body* were well disposed, which causes such an impression in the *Brain*, which being instituted by *Nature*, to contest this good disposition and strength, represents it to the *Soul*, as a Good that belongs to it, so far as it is joined with the *Body*.

VII.
How it is that some certain Diseases abolish all Sense of Touch in Man.

In persons affected with the *Elephantiasis* or *Leprosie*, and in some that are craz'd in their *Brain*, and are, as they are commonly term'd, besides themselves, the sense of *Touching* is wholly taken away, tho' the *Locomotive Faculty* remains entire: For we often see *Madmen* go barefooted, and lie almost naked on the ground, their *Skin* being so benumb'd and senseless, that they hardly feel the incisions of a *Knife*, or the running of *Pins* or *Needles* into their *Flesh*.

This Case, tho' it be very difficult to unfold, by reason the *Nerves* convey both the *Instincts* of *Motions*, and the impressions of *Sensibles* to the *Brain*; yet it may be affirmed, that not the same *Fibres*, which attend upon *Motion*, are inservient to the *Sense*. For the *Musculous* and *Tendinous Fibres* execute the motive power, but the *Membraneous* receive the sensible *Species*, and convey

it to the *Brain*: So that it may possibly be, that the *Hurt* or haply the *Loss* of the *Sense* of *Feeling* may be caused by reason of some harm inflicted upon the exterior *Members*; as namely, when their *Fibres* are overlaid by some gross matter, or condens'd by excess of *cold*. On the contrary in the *Palsie*, it falls out that the *Senses*, and not the *Motion* is hindred, in regard that not the same *Fibres* that are the *Organs* of *Sense* are the *Organs* of *Motion*.

The *Skin* being pulled off from any part of the *Body*, *Objects* are the more acutely felt.

This happens, because, tho' the *Cuticle* or upper *Skin* be intersperc'd with *Filaments*, by which the affection is transmitted to the *Brain*, yet it contains many insensible *Fibres*, which like *Dead Flesh* are not affected by any *Object*. In so much that they may be taken off with a *Penknife* without any *Pain* or *Sense*: Or at least it may be made out that they are harder than to admit of any *Impression*. For the *Interior Fibres* which compose the *Flesh*, being more tender and *nervous*, are therefore the more apt to admit even of the least affection, and consequently are the more sharply prick'd with the asperity of a *Body*.

He who leans or puts a stress long upon any part of the *Body*, makes it stupid and numb'd, or, according to the vulgar expression, *asleep*; as hath been already intimated.

The Reason is, because by the said compression the *Spirits* are stopp'd, and all access to them obstructed; whence it comes to pass that when that part of the *Body* is relax'd, there is felt a little pricking, trouble or pain, by reason of the *Spirits* being at length agitated afresh, and repeating their interrupted motion.

It is vulgarly affirmed, that *Females* in the *Summer*, and *Males* in the *Winter* are most desirous of *Copulation*.

The Reason is, because the *Bodies* of the *Males* being more hot and dry, the *Summer* hath more power by exhalation to dissipate the *Animal Spirits*; whereas the *Winters Frost* condenses more, and preserves them intire: For in *cold* and *moist Bodies*, such as are those of *Females*, the *Summers* heat cherishes, and calls forth the *Spirits*, when as *Winters* cold blunts and repels them.

Of all *Animals* whatsoever, *Man* excels in the faculty of *Feeling*, and more distinctly perceives the first qualities of things, and other qualities relating to *Touch* in general, as *Humidity*, *Siccity*, *Hardness*, *Gravity*, and the like.

This Prerogative we commonly attribute to the *Spider*, who (as the *Boar* surpasses in *Hearing*, the *Ape* in *Tasting*, the *Vultur* in *Smelling*) is generally believed to be the more quick and vigorous in the faculty of *Feeling*; but this vigorous sense of *Touch* is upon no other account ascribed to the *Spider* than upon its quick perception of *motion*, when sitting in the midst of its *Web*, it perceives the *Fly* lighting upon the most remote part thereof, which is not in the least to be wondred at, since all the *Lines* are equal which are derived from the *Center*; so that lying in ambush in the middle, and holding the extremities of the *Threads* with its *Feet*, it easily deprehends all things which are transacted about it: But *Man* surmounts in the Prerogative of *Feeling* above all *Creatures*, by reason of the excellent temperament of his *Skin*, and

VIII.
How it is that the Skin being pulled off, Objects are felt more acutely.

IX.
How it is that any part of the Body becomes numb'd, or as they call it, asleep.

X.
That Males in Winter, and Females in Summer are most desirous of Copulation.

XI.
Man excels other Animals in Feeling.

and the subtle contexture of *Fibres* in which he excels all other *Animals*. His most excellent Faculty of *Touching*, is most chiefly discerned in the hollow of his *Hand*, and the extremities of his *Toes*, because that in those parts the *Filaments* of the *Nerves* are very slender, and moved with small ado. Whence it happens, that, as it were by instinct of Nature, when we go about to grope out any thing by *Feeling*, we reach out our *Hand*, but chiefly make use of the extremities of our *Fingers*.

XII.
The Sense of
Touch is
sometimes
augmented
by the fail-
ure of the
Sense of
Sight.

The Sense of *Touching* in some Men is so admirable, that it mightily helps the want of *Sight* in them, as appears most evidently in that renowned *Organist* of *Falcombourg*, who by his *Touch* alone, not only knew how to play most elegantly, but also could distinguish *Coins* and *Colours* of all sorts from each other; nay, and to very great advantage plaid at *Cards* with other persons, especially if he dealt the *Cards*, since he could easily understand by the *Pulps* of his *Fingers* what sort of *Cards* they were which he dealt to his *Partners*.

Of this thing there can be no other cause assigned, than because all persons, like the said *Organist*, deprived of their *Sight*, are by consequence no longer distracted by the multiplicity of external *Objects*, which hinder us from keeping our thoughts fixt upon any particular thing, so that by daily exercise, and a most accurate attention of all circumstances, it must needs of necessity be that *Blind Men* must in the Sense of *Touching*, for examples sake, as in the rest of the *Senses*, of which they are not deprived, excel all other Men.

XIII.
How it is
that in
touching,
the Object
seems to be
double.

Touching sometimes causes the *Object* to seem to be felt double, when as indeed it is but single: For the *Globe G*, being touch'd with the two *Fingers* laid a-crofs *D* and *A*, feels like two.

The Reason is, because while these *Fingers* keep themselves thus cross'd, the *Muscles* endeavour to deduce *A* into *C*, and *D* into *F*: Whence it happens that the parts of the *Brain*, out of which the *Nerves*, intervient to these *Muscles*, derive their original, are disposed in such a manner as is requisite for the said *Fingers* to be, viz. *A* into *B*, and *D* into *E*, and consequently that the two *Globules* *H* and *I*, must seem to touch each other. For when we lay the *Middle Finger A*, for example sake, upon the *Fore Finger B*, then the part of the said *Fore Finger B*, which being next to the *Thumb F*, is disposed together with the said *Thumb*, to lay hold upon any thing, and the part of the *Middle Finger A*, which joined to the *Ring Finger H*, is apt, together with the said *Ring Finger*, to catch hold on any thing, are not very capable, both at the same time, to grasp the said *Globe*. And the *Mind* then seated in the *Glandule*, perceives the *Globe*, not as single but double, and as it were placed in two places; and from the different Motion of the *Nerves* hath an apprehension of two *Globes*, not one.

XIV.
How things
appear
double.

By the same Reason, or not much unlike, when we hold up one *Eye* with our *Finger*, and behold any thing with dislevered *Rays*, we cannot but perceive it as double: Forasmuch as the superior *Rays* of one *Eye*, are ever wont to act with the superior *Rays* of the other; as likewise the Middle with the Middle, the Inferior with the Inferior, and to conspire together to the perception of one

and the same thing, as it were to make a report that it is indeed but one and the same. But if the *Eyes* chance by any means whatsoever, to be so distorted, that the *Right Rays* of one *Eye* agree not with the *Left Rays* of the other; or the Superior *Rays* of one with the Inferior of the other, all single *Objects* whatsoever are look'd upon as divers. As in a *Concave Glass*, the Flame of a *Candle* appears double, by reason that from the *Left Side* of the said *Glass*, the *Rays* are reflected into the *Right Eye*, and from the *Right Side* into the *Left Eye*.

CHAP. II.

Of Taste.

THE same sort of *Meat* doth not always please. For that which is gratefully receiv'd by the *Hungry Stomach*, becomes unpleasant and unfavoury to the same *Stomach* well satisfied; and the same *Drink* which delights the *Thirsty*, becomes loathsome to those that are fill'd with *Drink*.

I.
Why the
same sort
of Meat is
not always
agreeable
to us.

The Reason is, because all *Savoury Things* impress an affection in the *Organ* of *Taste*, according to the Contexture and disposition wherewith it is imbued: So the *Tongue* over dry, or void of Moisture, perceives little or no taste in any thing; and so on the contrary, a *Tongue* which is turgid or swelling with too much Moisture, and hath its pores stop't up with liquid Bodies, cannot be affected with any *Savour*. Since therefore the disposition of the *Tongue*, in a person fasting, and in a Person full, is quite different; hence it comes to pass, that the same sort of *Meat* or *Drink* is not always in the same manner received in its little chinks and small pores, and consequently induces a different affection therein. This may possibly arise from a Mutation of *Temperament*, whilst the *Spittle*, proceeding from the *Stomach*, according to the qualities of the *Humour* wherewith the *Stomach* is repleated, mingles it self with the particles of the *Meat* in the *Momb*, and promotes their acting.

This very *Experiment* alone is sufficient plainly to discover how grossly the *Peripateticks* are deceived when they affirm, that the savor in *savoury Bodies* does every way agree with the sentiment we have thereof. Since were it according to their opinion, it would follow, that the same Man could not at several times have a different taste of the same sort of *Meat*, which is contrary to experience.

II.
The Great
Error of
the Peripa-
teticks
about Sa-
vors.

It may also happen, that from the various situation of the *Nerves* conducing to *Taste*, all sense of *Taste* may be taken away, according to the mention made by *REALDUS COLUMBUS*, of one *Lazarus*, vulgarly surnamed the *Glass-devourer*, who not distinguishing in any thing bitter from sweet, fresh from salt, used to devour *Stones*, *Glass*, *Charcoals*, *Fish* drawn alive out of a *Fish-pond*. Of which Monster of Nature, when after his death, a Dissection was appointed by a Person of Curiosity inquisitive into the Cause of so uncouth a thing: It was found that the sixth Conjugation of the *Nerves*, which was ordained by Nature, for *Tastes* sake in other Men, in this *Glass-devourer* reached neither to the *Palate*, nor

to

to the *Tongue*, but turned back to the hinder part of the *Head*.

IV. They that are troubled with the *Faundise*, think all sorts of *Meat* they *taste* to be bitter, and imbued with a quality noxious to them.

This mistake proceeds from the *Choler* which is diffused through the *Tongue*, for such a sort of *humour*, mingled with the *Spittle*, infects the *Meats*, and imbues and depraves the *Organ of Taste* with its bitterness: So that these *Icteric* Persons are not so much deceived about the *Affection* impressed (for they do really *taste* that which is bitter, and the *Organ* is certainly ill affected) as about its Cause, since they look upon the said *Savor* as received from the *Meat*, when as indeed it is to be imputed to the *humour* only. For some without any *Meat*, seem to themselves to *taste* a certain *Savor*, in regard this *humour* sliding into the *Tongue* or *Fauces*, vitiates and corrupts their *Temperament*. The same thing happens in the *Tomb*, as when any one fancies he feels the force of *heat*, and thinks *Fire* to be applied to his *Body*, when indeed *Fire* is far enough off from it, and only a defluent *humour*, either a tension of parts alone, or a tumor with it impresses such an affection, as *Flame* the *Instrument of Pain*, were it present, would impress.

V. The *Tongue* is the chief Indicator of any *Disease*, and by whatsoever *Infirmity* we are oppressed, 'tis thither we have recourse for all the *Signs* and *Discoveries* thereof. In so much, that it hath been always the custom of all *Physicians*, the first thing they do, to bid the *Patient* hold out his *Tongue*.

The *Reason* is, because the *Tongue* being the tenderest of all parts of the *Body*, is most easily wrought upon; for since it is of a *Spongy* Nature, and abounding with *Blood*, it is soon seized with the force of a *Disease*, or infected by vitiated *Blood*, by both which being ill-affected, no wonder if it soon discover the alterations of the *Body*, and reveal with what infirmities it is afflicted; sometimes it looks *Red*, sometimes *Yellow*; and when its plexure is singular, it is *subject* only to a singular affection.

VI. They that take a *Crust* of *Bread* with a draught of *Wine*, for *Breakfast*, seem in a manner to feel certain prickles in the innermost recess of the *Tongue*.

Because the *Meal* of which the *Bread* is made, is for the most part kneaded with *Ferment* and *Salt*, the latter whereof still imparts something of *Acrimony*: For the parts immingled are rendered more sharp, than those that are more solute and loose, and adhere to it with a lesser tie. Whence *New Bread* pleases more, and is more grateful to the *Organ of Taste*, in regard the particles thereof being less interwoven, are better chewed by the *Spittle*, and more gently move and affect the innermost tract of the *Palate*.

VII. They that have not the faculty of perceiving *Savors*, must in all likelihood be deprived also of the sense of *Smelling*, as is many times observed in a *Distemper* called the *Pese*, where the sense of *Smelling* being taken away, that of *Taste* also fails.

The Cause of this Consequence depends upon the *Corpuscles* which are inservient to both *Senses*; forasmuch as they are the same, and differ in nothing but their various Expansion. For the sense

of *Smelling* proceeds from particles of *Emanations* flying in the *Air*, which being mixt with the *Air* we breathe, are conveyed to the *Nose*. But the particles which conduce to *Taste* are indeed less subtil, and are to be imbibed by some *humour*, that they may smite the *Organ* of the *Tongue*; yet they are really the same, and are only distinguished in this, viz. that being diluted with *humour*, they cause *Savor*, and being exhaled and transmitted through the *Air*, they cause *Odour*.

Many who have an aversion to certain sorts of *Meats*; for example, to *Old Cheese*, or the like, when they happen to *taste* of the same unawares, certainly contract a great loathing, and immediately, if possibly, vomit it up; but if they cannot, presently fall sick, or find themselves very much indisposed.

The *Reason* is no other than that the said *Meats*, either by their *Odor* or *Vapor* inflict damage upon those *Fibres* or *pores* of the *Nerves*: For while they ill affect the *Nerves* inserted into the *Ventricle*, they first cause a tremour of the *Lips* or *Nauseation*; and if the said *Vellication* of the *Nerves* continue, there will at length follow a *Vomiting*, which *Nauseation* ever precedes; nor is the said *Nausea* any thing else than the *tremulous Motion* of the innermost *Membran* investing the *Mouth*, which proceeds even from the *vellication* of the *Ventricle*, as to which *Tunicles*, that of the *Mouth* is continuous.

It may also be otherwise said, that the privation of *Taste* induces the failure of another *Sense*, viz. *Smell*; by reason that both *Sensories* being planted near each other, are apt to be both together overwhelmed and glutted by the same *serous matter* squeezed out of the *Blood*: In as much as the *tubulated Membrans* of the *Nostrils*, and the structure of the *Tongue* it self consist of a very rare, and as it were spongy composition: Wherefore the *pores* of either *Organ*, and the passages from the *Serous* floating matter are apt to be overflowed, and the *sensible Fibres* in both at the same time to be obstructed; to which may be added, that whereas the *Nostrils* and *Tongue* ought to be supplied with a continual *moisture*; both of them as they most grievously, and more than other parts, undergo a deflux of superabundant *Serum*, so both are equally obnoxious to the same mischief upon any slight cause.

Sick Persons, and those that are of a *Crasie Body*, reject all sweet things, and are only delighted with what is *acid* and *sharp*.

The *Reason* why these sickly people have such an aversion to all *Meats* that are sweet, is because of the vitiated *Blood*, and the malignant quality of the *Morbifick Humour*, which being for the most part *Choler*, breaks into the *Tongue*, as being a very tender place, and causes innumerable obstructions, hindring a just perception of the *Meats* that are presented. Hence it is that *sharp Meats* please the *Sick*, in regard the *Tongue* is covered with a certain *Uliginous tegument*, so that sweet things cannot enter and pass through it; whereas *Acids* affect in another manner, as consisting of long and inflexible parts. Nor is it for any other cause that *Beasts* covet *Salt*, and are very much taken with the eating thereof, because their *Tongue* is scabrous and rough, and overlaid with a certain *Crust*.

VIII. When *Nauseation* comes, or a vomiting up of certain *Meats*.

IX. Why upon defect of *Taste*, defect of *Smell* should follow.

X. Why sick Persons have an aversion to *Meats* that are sweet.

XI.
Sweet
Meats hin-
der others
from being
relish'd.

Who ever hath a relish of *sweet things*, hath not a right relish of other *Meats* of a more accurate *taste*.

Because all *Esculent* or *Eatable Things* are no otherwise *tasted*, but so far as the *Tongue* induces and insinuates within the *pores* certain *Savoury Corpuscles* reduced and made small by *manducation* or *Chewing*. But whereas *sweet things* are *viscous* or *clammy*, and for the most part obstruct the passages of the *Tongue*, they hinder the supervenient *savoury particles* from being carried into, and affecting the *Sensorium*. Wherefore the better to restore again the faculty of *Tasting*, we use to feed upon *sharp* or *salt things*, to the end that they may loosen the passages of the *Tongue*, and wear away, and take off the inherent *Viscosities*.

XII.
How it is
that Spittle
is excited
at the sight
of things
grateful to
the Palate.

Spittle at the sight of things grateful, and with which we are chiefly delighted, increases and fills the *Mouth*.

This happens by reason those sorts of *Meat*, which before are apprehended to be grateful to us, now again excite an *Appetite* in the *Soul* to receive them: Whence it comes to pass, that the *Soul* being intent upon this alone, sends more copious *Spirits* into the *Glandules* of the *Mouth*, so that they being so much the more compressed, the *Spittle* at the sight of those grateful appearances is squeezed out in greater abundance.

CHAP. III.

Of the Sense of Smelling.

I.
Man is the
dullest of
all Animals
in the sense
of Smelling.

OF all *Animals*, *Man* is thought to be that of the grossest *Smell*, and who the most slowly takes in the *Emanations* flowing from *Bodies*.

The Reason is fetch'd from the Constitution of the *Brain* itself, which being spongy, and abounding with much moisture, blunts the edge of *smell*, and is the less affected by the said *Emanations*. Hence those that are troubled with a *Catarrh* or excessive deflux of *Humour*, many times have no smell, in regard the *pituitous Humour* blocks up the *Nostrils* and the *Cribriformous* or *Sieve-formed Bone*, to which the *Emanations* flowing, clot together, and are in a manner choak'd up: So likewise little or no *smell* is perceived under *water*, in regard the *moisture* takes in the exhaled *Corpuscles*, and obstructs their diffusion.

II.
They who
have large
Nostrils
smell best.

They who have broad and open *Nostrils*, and in whom the spongy passages of the said *Bone* are from their Birth dilated, admit more easily and strongly all *Odours* or *Smells*.

The Reason is, because a greater abundance of *Emanations* is conveyed through those Cavities to the *Brain*, which being gathered therein, and with mutual application aiming at the *Nerves* of the *Brain*, impress the greater affection. In a manner not much different from that whereby the *Air* inspired through a broad and well purged *Ear*, enters more copiously the *Auditory Passage*, or whereby the *smoke* ascends more easily through a wide *Chimney* than through a narrower.

III.
The Ox,
Goat, and
the like,

Hence in dissections, we see in a *Goat*, *Ox*, *Sheep*, and other such like *Animals*, that feed upon *Grass* and *Herbs*, that the *Mamillary Pro-*

cesses are larger than in *Carnivorous* or *Flesh-eating Animals*, because they have more need of an exquisite *Organ* of *Smell* to distinguish divers sorts of *Herbs*, and to select the more agreeable from the more noxious. For the same reason *Brute Animals* are indued with far larger *Olfactory Nerves* than *Man*, by reason that they discern their food by no other guide than *smell* alone; whereas *Man*, as one indued with *Reason*, knows many things by *Reason* and discourse, and is led not so much by *smell* as by *seeing* and *tasting*, to the choice of his *Diet*.

Those things which are grateful in *smell* to some, are to others ungrateful.

The Reason lies in the diversity of the *pores* in the *Olfactory Nerves* of this or that *Person*; so some are highly delighted with the *smell* of *Roses*, while others reject them, in regard the *Volatile Particles* exhaling from *Roses*, have such a *Figure* that they can easily, and without any trouble pass through the *pores* of some, but not without great difficulty and violence the *pores* of others; whence in these there arises a notable *aversion* of the *rose smell*, in the others a wonderful delight therein. So *Men* without any disgust or trouble accept the *smell* of *Musk* or *Civet*, which at the same time to *Women* generally is odious and pernicious. Nay it causes in them *Hysterick Passions*, whereof there can be no other reason but this, *viz.* that the *Volatile Particles* of the *Civet* or *Musk* cannot so easily and freely pass the *pores* of a *Woman's Body* as of a *Man's*, whence *Women* are most refresh'd by the odour of the most ill-scented things, as *As-fa-fatida*, and such like *smells*, which *Men* can hardly endure.

A *Man* that *stinks*, as they say, above ground, is not sensible of the ill-scented *Vapour* proceeding from him.

The Reason is, because the *Organ* of *smelling* is so disposed, that the inbreathed *smell* cannot be perceived but according as it falls upon adverse *Fibres*; for there are in the *Nostrils* certain *Valvules*, or little *Caverns*, whose *Mouth* towards the extremity of the *Nose* is most open, and consequently the *sense* of *smelling* is only effected, when the *Breath* emitted from without arrives at the *Nostrils*, and falls upon the adverse *Fibres*: But when the fore-said *Valvules* lie not open to the expired *Breath* (that is to say, because it falls not upon the adverse *Fibres*) it comes to pass that the *Organ* of *smell* is not touch'd, and consequently no affection follows.

Those that long hold any *perfumed* thing to the *Nose*, or live for any considerable time in a place full of *perfumes*, are at last sensible of no *Odour* at all.

This happens because the *Emanations* or *Breathings* from *Bodies* perpetually, exhale forth, and are successively conveyed through the *Air* to the *Nostrils*, which when they arrive to, they do not immediately return back, but stick there some time, and so fill the *Appendices* or *Suburbs*, if I may so call them, of the *Brain*, that those which follow after cannot penetrate them and make a fresh assault upon the *Sensorium*. This appears plain by those that lay among their Cloaths *Civet* or *Musk Bags*, or powder their Hair with *Jessamin* or other *sweet Powders*. Forasmuch as after some time, they cease to have any *Odour* of them, and

excel other
Creatures
in smell.

IV.
Those things
which are
grateful in
smell to one,
are very
ungrateful
to another.

V.
A Man that
stinks is not
sensible of
his own
stink.

VI.
Continual
Odour or
Perfume
ceaseth to
be smelt.

as if they were no longer respiring, are not in the least affected with any *Scent* of these *exspirations*: So that those who love to *smell* to *Flowers*, or to enjoy the *Flagrancy* of any *place*, hold them by turns to their *Nose*, and go and come several times to the *place*, to the end that the *particles* of *Flowers* or *Spices* may have time allowed them to depart from the *Organ* of *smelling*, and way be made for those that come after.

VII.
How it comes to pass that a Woman with Child miscarries upon an ill scent.

Sometimes it happens that a *Woman* with *Child* miscarries upon an ill *smell*. I knew one who *smelling* the *Snuff* of a *Candle* blown out, fell thereupon in *Labour*, and brought forth an *abortive Child*, when near her time, and that not without great danger of her *Life*.

The Reason is, because ill *Odours* grate and perplex as they pass by, and so compress the *Organ* of *smelling*, that such a sort of *motion* being transmitted to the *Brain*, affects also the *Fibres* of the *Womb* which are connected with the *Fibres* of the *Birth*, and induces such a disposition, that the *Birth* forcing the *Umbilicar Vessels*, breaks forth, and makes its passage out. On the contrary a grateful *Odour* refreshes and comforts the *Gravid Person*, and renews her strength, which suffers from the grievous and *fetid Vapours* wherewith she is chiefly at that time infected, and therefore must needs be relieved by a *sweet Odour*, as it were by a *tenifying* or *emulgent draught*, unless by chance the *Womb* labours with an *overcorrupt Humour*, and swells with *Crudities*.

VIII.
Smells are better perceived in Summer than in Winter.

Smells are less scented in *Winter* than in *Summer*, and hence it is that *Hounds* follow the *Game* better in *Summer* than in the *Winter*.

Of this there can be no other reason than that the *Heat* which prevails in *Summer* dilates or widens the *pores* of all *Bodies*, which causes the *Vapours* the more easily to be diffused and spread through the ambient *Air*; whereas the cold by condensation compresses the *pores* and hinders the *particles* of *Bodies* from being resolv'd, and turn'd into *Vapour*; almost in the same manner as *Smoke*, which being excited by the *heat* of the *Fire*, is extended; but being invironed by *Frost*, is contracted, and ascends in slender *Columns* through the *Frigid Air*. Altho' it may also be said that *Summer* is more apt and disposed for the receiving of *Odours* than *Winter*, because in *Winter* the *pores* of the *Body* are contracted, and less of *Vapour* is educed out of them; whereas in *Summer* all *Odours* are too much dissipated by reason of the *heat* of the *Air*, and by the over-abundance of them, the *Organ* of *smelling* is disturbed and disordered.

IX.
Why Flat-Nosed People for the most part send forth a stinking Breath.

Those who have *flat Noses* send forth for the most part a very unfavourable *Breath*, whence proceed the many *scoffs* of *Poets* upon *Flat-Nosed People*, in which their *stinking Breath* is brought upon the *Stage*.

The Reason is, because the *pores* through which the *Humour* flowing from the *Brain* to the *Nostrils* passes, are obstructed, or at least are too narrow for it to run freely through them, so that by gathering and clodding there, it corrupts and putrifies. To which also may be added, that *Flat-Nosed Persons* have for the most part vitiated *Lungs*, in regard that since the *Air* cannot pass through so short a passage or winding of the *Nostrils*, so as to be well purged, the *Brain* and *Lungs* must needs be infected, and thereby cause a *stinking Breath*.

Those who excel in *Wit*, are dull of *smell*, and sometimes totally lose that faculty.

The Reason is, because those are most *Ingenious*, whose *Brains* are best purged, that is, exonerated of all their superfluous and excrementitious pituitous *humour*, from which the *Brain* being freed, is rendered the more prompt to execute those *works* which depend upon the faculty of *Wit*. But they who have a *deflux* of *Flegm* or *Spittle* distilling down to the *Nostrils*, must certainly of necessity become yet more dull of *scent*, in regard the *Flegm* obstructs the *Nostrils*, drives away the supervening *Odours*, and blunts their *Edge*.

X.
The most ingenious Persons are the most dull of smell.

CHAP. IV.

Of Hearing.

WE are quicker of *Hearing* by *Night* than by *Day*.

The Reason is, because in the *Night* the *Air* is still and quiet, and not troubled with any loud *noises* or *sounds*, which in the *Day* hinder us from hearing another's *Voice* at any distance, in regard it presently meets with various undulations of *Air* raised from external *sounds*, into which immediately it transfers its *motion*, so that the *Voice* becomes as it were stifled in the *Air*.

Speech among *Men* is various, by reason that some *Men* in *speaking* utter a great and manly *sound*, others an indifferent, and others a shrill and effeminate voice.

The Reason is, because in some the *Aspera Arteria* is more ample or large, and so puts forth a grave or big *sound*; but they whose *Aspera Arteria* is of a mean or middle size, send out a *Voice* or *Tone* somewhat sweeter, and as it were mixt of a grave and shrill *Tone* together: Lastly, they who have it narrow and straight, utter a *Tone* yet more shrill and also soft, such as is for the most part that of *Women*.

Those that have their *Ears* cut off, relate that they confusedly take in all *sounds*; so they seem to hear upon all occasions some inarticulate *sound* or other, as the chirping of a *Grasshopper*, the murmur of a *flowing Stream*, or the like.

The Reason is, because the exterior *Ears* are hollowed and enlarged, so that the moved *Air* by passing through the *turnings* and *windings*, is gathered and made intense. For the *Air* enters so much the more copiously into the *Auditory Passage*, as coming from an ampler *space*, it falls into the *streights*. So that *Deaf People* oft-times supply the defect of that *Sense* by holding their *Hand* hollowed, or a *Horn* to their *Ear*; for as the *sound* is enlarged in winding *Cavities*, and enters the *Ears* with the greater force; so *Animals* that have moveable *Ears*, at the bearing of any *noise*, prick them up that the *sound* may enter in more copious and direct: Therefore the *Ears* being cut off, the *sound* falls directly into the *Auditory Passage*, which causes the failure of that determination which ought to be, and which happens but at the *instant* of the said *Illapse*. And thereupon the *sound* comes to them no other way, than if it proceeded from various parts, as it happens in the instances before-mentioned.

I.
We hear better by Night than by Day.

II.
How Human Speech comes to be so various.

III.
How it is that upon the Mutilation of the Ears they receive Sounds confusedly.

IV.
A Tune
plaid on a
Pipe is more
charming
than that
plaid on a
Harp.

A Tune plaid on the Pipe is more sweet and charms the Organ of the Ear, more than if plaid on a Harp.

The Reason is, because the sound of a Pipe is more continuous and less disjointed, than that of a Harp. For in regard we are delighted with modulation, and take greater pleasure to hear proportionate Movements, we are most taken with those which keep a certain Tenour, and smite the Soul with repeated strokes. To this may be added, that the sound of a Pipe is as the Voice performed with respiration, and consequently the Notes are the more easily mixt one with another. For the Harp produces a certain asperity, and howsoever struck creates harshness to the Ear.

V.
Persons
smitten by
a Tarantula,
are cured by
Music.

Those that are smitten with the sting of a Tarantula, are said to be cured by Musick; in so much that let a Musitian be brought to the Person so smitten, and let him sing by him to his Lute or Harp, and the Patient shall rise from his Couch as he were wakened out of his sleep, and shall so exercise his Feet for some hours by his strenuous Dancing, that all the poison shall effectually evaporate by sweat out of his Body.

The Reason of this so wonderful effect, is to be attributed to the motion caused by the Musical Instruments, by which the Drum of the Ear, and afterwards the Brain being smitten, by their help, also the Arteries, Nerves and Muscles are excited; so that upon the excellent and well-followed performance on the Harp, the Patient to free himself from the Tarantula's poisonous stroke, falls a dancing with all his might; and by this means not only hinders the force of the Venom from spreading farther, but also by the continual agitation of his Body expels and breaths it out by sweat, in regard the playing on the Harp so far stirs up a motion in the Nerves, as to dissipate the force of the Venom which possesses the Arteries.

VI.
Why some
so stung are
not cured
by Dancing.

But if it happens at any time that some are not cured by dancing, (for it hath been found by experience, that persons stung by the Tarantula have danced thirty or forty years without cure.) It is because the Sting possessing the Arteries, Nerves and the Spirits, contained in them, hath been more tenacious and viscid, than to be capable of exhaling and being rarefied.

VII.
Deaf Per-
sons have
been
brought to
hear better
by a great
Noise made
about them.

It hath been known that persons of vitiated Ears, and almost deprived of the sense of Hearing, have by a very loud sound (for example of Drums and Trumpets) been brought to that pass as to receive the words of people speaking to them, and to give answers to their Interrogations.

This happens from the Drum plac'd in the recess of the Ear, which being loosened, admits of no affection from the soft impulse of sound, but upon the din of a very great noise, acquires its due tension; so as commodiously enough to perform its office; and thus the Cause is made plain why a certain Deaf Man of Orleans living near a great Steeple of Bells could easily hear the words of those that stood talking with him, so long as the several Bells were ringing; but upon the ceasing of that noise, he fell back to his wonted deafness, and could no longer hold discourse with those about him. So a certain young Nobleman born near Oxford, plainly heard the words of

those that were near him while he passed through London-streets in a Chair, or any loud Noise was made about him, by reason that upon a notable concussion of the Air, the tympanum was reduc'd to its due tension, and acquir'd its turgescence.

When the Breath is kept in, we receive so much the more easily and plainly the approaching sound; whence in hearkning earnestly to any sounds which come from afar off, we commonly keep our Breath.

The Reason is, because all expiration is a motion ad extra, as my Lord Verulam calls it, rather repelling than attracting the sound; so upon whatsoever thing we are most industriously bent, and labour with most vehement intension, we stop and keep in our Breath; for a catching with a difficulty at any flying sound is but a certain sort of laborious work.

It happens frequently, especially in a confused multitude of sounds and words, that we presently hear the speeches of some certain Person; but those of another Man, tho' speaking at the same time, we are not sensible of, till some time after.

The Reason is, because the sound or voice of one Man taken in with that of another, is not altogether at the same moment of time, conveyed to the common sensorium, but one after another enters the Ear. Whence it is probable in such a case, that the first sound, one winding of the Ear alone being gained, is thereupon sooner transmitted from the first Branch of the Auditory Nerve to the common Organ; but the later as it were sensible, because it cannot be transferred together at the same time in the same Nerve, making therefore another circuit through the second winding, it is at length removed from the second Branch of the Auditory Nerve, and consequently succeeding the former, is later taken in.

Let any one be plac'd in a Chamber, and he shall more clearly and distinctly hear the words which are delivered from without, than were he plac'd without, he could hear them, being utter'd in the Chamber.

This comes to pass, because the sound diffus'd through the Air, is reflected by interposed Bodies, as sufficiently appears from an Echo; for in regard there are many solid Bodies within the Chamber, as Walls, Planks, Tables, &c. which drive back the emitted words, it happens that the sound becomes the stronger, and more forcibly smites the Ear, than in the free Air, where those obstacles are not to be met with, from whence sounds result. Hence it is that he who speaks from any high place is better heard by him who is beneath, than on the contrary he that speaks from a low place is heard by one above; because more Bodies occur from which the voice may be reflected, whilst it tends downwards, than whilst it flies up, and wanders through the Air.

The sound of a Bell happens sometimes to be heard in such a manner, that it seems to proceed not from the place where it is, or whence it really proceeded, but from the opposite part.

This fallacy proceeds from the reverberation of sound, which coming last to the Ear, seems therefore to proceed from that place from whence it was reflected: For as by the reflection of Rays, a thing appears not where it is, but in that place whence the Rays are last derived: So a Bell or any other

VIII.
How it
comes to
pass that
by keeping
in the
Breath, we
hear the
more plain-
ly.

IX.
We hear
not all
Sounds
with like
suddenness.

X.
Words pro-
nounced
without,
are better
heard from
within a
Chamber,
than on the
contrary.

XI.
Why the
sound of a
Bell is not
always
heard from
the place
where it is.

other *sonorous Body* is judged to be in that place where the *sound* came last to the *Ears*: For a *sound* reflected by an *oblique Line*, arrives at the opposite part. In like manner a *Bell* being rung from the *Northward*, if the *Chamber Window* where we are, open to the *South*, we seem to hear the *sound* from the *Southward*: So if a *Beggar*, as we are sitting in a *Chair* or *Sedan*, make his *Speech* on that side the *Chair* where the *Glass Window* is up, he will seem to be on the other side where the *Window* is open or let down.

XII.
Whence it is that a kind of murmuring sound is heard upon stopping the Ears.

If any one stop both *Ears*, or either of them very well, he will nevertheless hear a certain tremulous and murmuring *sound*.

The Reason is, because of the agitation of the *Air* included in the *Ears*: For in regard there is a continual efflux of very much *Breath* from the *Ears*, if upon a stoppage applied, the said efflux be barricadoed or shut up, the *Air* pent in within the Cavities of the *Ears*, and impatient of its narrow confinement, drives and forces into the *tympanum*, from which vehemence of agitation a certain murmuring noise must needs arise, and affect the *Ears* in such sort, as if it proceeded from some sonorous object. Which that it is so, is from hence sufficiently evident, namely that a vehement external noise being raised, that internal humming sound is suppressed; and that indeed for no other reason but because a new agitation inwardly induced, directs the tumultuating *Air*, and forms it into *Rays*.

We oftentimes equally soon, at one and the same distance hear two unequal sounds.

This so happens, for that the agitation of the *Air* which makes the noise, hath always an equal swiftness at the same distance, tho' it is made with a greater or lesser effort, so that the noise of a sonorous Body extends it self with the same swiftness at one and the same distance, altho' the Body be smitten with an unequal force: For a greater force may indeed contribute to the making of a greater sound, but not in the least to the making it to be of a farther extent.

XIII.
How it is that two unequal sounds are equally quick.

That famous *Diver* in *France*, wrapt up in his own *Machine*, which takes not away *Hearing* from any one so long as he continues above water, affirms that when he was about ten fathoms under water in the *Ocean*, not far from *Diep*, he heard not the least report of those *Guns* which the *Ship* was obliged to discharge as it sailed out of the *Port*.

The Reason is, because sound cannot be procreated, except in a moveable Object; so that if that *Medium* through which it is to be transmitted, cannot conceive any tremour, or resist the tremour of other Bodies, it can produce no sound. Wherefore since the bulk of the *Water* is so great that it cannot be agitated by the moved *Air*, and resists its tremours: No wonder if the noise produced above the waters reach not so far as the bottom; for as we find by experience, that a *Stone* falling into a *River* from a high place, makes no noise when it come to the bottom, tho' it hit against other *Stones*: So an exterior sound cannot so penetrate the extraordinary height of the *Waters* as to be received by it; and so they who swim upon their *Backs*, scarce hear any thing so long as they have their *Ears* immerst, and lie beneath the surface of the *Water*.

XV.
Fishes in the water hear not.

Whence it is evidently made out, that all *Fishes* are deaf, or void of bearing, except those of grand

bulk, as the *Whale*, *Dolphin*, the *Phocas* or *Sea-Calf*, which raising their *Heads* above *Water* both take in sounds, and utter a voice from their Mouth.

The Reason why other *Fishes* seem to be deaf, or void of bearing, is because they are wholly mute; for there seems to be that correspondence between the *Voice* and the *Ear*, that those very Animals which want *Voice*, the same also are destitute of *Hearing*, by which at the same time the word and the thing signified thereby are apprehended. Now if it be objected that *Fishes* decline the noise of the *Oars*, and that the *Fishermen* commonly beware of the tottering of their *Boat*, or of making a noise with their *Nets*, when they beset the *Shoal*: I answer, that all this is, left upon the motion of the *Water* stirred up by the force of the *Oar*, or the overmuch tottering of the *Vessel*, the *Fish* should apprehend the said motion, either by touch or sight. For we may observe in a *Fish-pond*, that the *Pikes* and other sorts of *Fish* swimming therein, are terrified by no sort of noise, murmur or sound, but upon the least unusual agitation or motion made in the *Water*, they immediately fly and shift their places, and if being called to Meat they sometimes come; this comes to pass, either because they are mov'd at the sight of the *Person* calling, or because the *Water* is moved by the lowdness of the *Voice*.

CHAP. V.

Of Sight.

AS we go about to look upon any thing, both *Eyes* tend to the beholding of the said Object with one and the same motion, while in the mean time each of them hath its *Muscles* distinct, and proper to its self.

I.
Why the Eyes move both together.

The Reason hereof proceeds from the *Mind*, which when it sets its self intently to behold any thing, it is not to be imagined that one *Eye* is bent upon the beholding of that thing, and that the other is employed upon another Object; for by that means there would be a confusion of the *Rays*, and of the perception in the common sensorium. But both *Eyes* must necessarily be directed at the same time, to the same Object. And to this end the *Spirits* are always disposed to the service of those *Muscles* which are capable of converting both *Eyes* to this one place, and not to those which serve to draw either *Eye* one way, and another another; for the *Mind* is always bent upon seeing one thing; and tho' it often designs to have the sight of many things, yet to take the better view of each, it takes it in a certain order, and views them one after another; which may quickly be done, if the things to be seen are near enough and big enough to be easily and soon beheld.

Who ever looks upon a *Flea* near at hand, and extends his sight to a *Horse* or other Animal of like magnitude at a very great distance, they will appear equal, and offer themselves to view under the same magnitude.

II.
How a Flea and a Horse may both seem to be of the same magnitude.

This is evident from *Opticks*, by which it is thus made out, namely that the faculty of seeing, or rather the *Soul* residing in the *Brain*, apprehends Objects to be greater or lesser, according

as they were represented to the *sight* under a greater or lesser *angle*. So that when as a *Flea* being seen very near at hand, and a *Horse* at a remote distance, seem both under the same *angle*, they are look'd upon by the *Soul* as equal: For it is evident that an *Object* is therefore apprehended greater, because it impresses a greater affection upon the *Retin Tunicle* or *Optick Nerve*; and lesser so far as the lesser proportion of the *Organ* is affected. Hence it is that the farther a *thing* recedes from us, so much the lesser it appears; and by how much the nearer it approaches us, so much the bigger it shews, in regard the *Object*, by how much the farther it is removed from us, appears with so much the acuter and smaller *angle*, and impresses the lesser affection. The Reason of all this is, because while the *Object* recedes and withdraws it self by little and little from the *Eyes*, it is not only diminished as to its *circumference*, but as to all the *parts* which are turned towards the *Eye*, because tho' it always remits its *Rays* in like manner from each *point*, yet most of them according to the rate of their *recess* and *elongation*, slip beside the *Eye*, and are elsewhere disposed.

III. In like manner those things which are seen afar off, tho' they are square and angular, yet they seem round in regard the distance of the *angles* cuts off the excursions and asperities; so we receive *Convexes* as they were plain, because all inequality of *parts*, by reason of so great an interval totally disappears. Hence the *Sun* and all the *Stars* appear to our *sight* not *convex* but *plain*; for tho' their middle parts are nearer to our *Eyes* than the extreme, yet that difference is but very small, if compared with so great a distance.

IV. An *Image* of any one beheld in a *Looking Glass*, appears as much beyond it, as the *Spectator* stands on this side it.

The Reason is, because the *Spectator* beholds his *Face* in the *Glass*, not as fix'd therein, but as sliding from him; and consequently the matter is to be considered, as if the *Spectator* were from the *Looking Glass* behind himself; whence it comes to pass, that the same *distance* is repeatedly apprehended by a reciprocal comparison: And because this *reflexion* causeth no necessity of the *Spectators* being transferred into the place of the *Looking Glass*, or altering his situation to be converted again into himself, it comes to pass, that after the *Axis* which is directed from the *Spectator* to the *Glass*, he immediately receives an *Axis* which tends from the *Glass* to the *Spectator*; and because of the unalterableness of the *situation*, hath both for the same continued *Right Line*, whose middle is from the *Spectator* to the *Glass*, the other half from the *Glass* to the *Image* beyond the *Glass*, where the *Spectator* represents from whence he comes.

V. An *Object* which appears too confused, as being too near the *sight*, may distinctly enough be seen, if any one behold it through a little hole made with a *Pin* or *Needle* in a *Card* or piece of *Writing Paper*.

The Reason is, because the *Eye* then receiving a lesser quantity of *Rays* from every point of the *Object*, every one of them describes its *Image* alone in a very narrow space; and so they which proceed from the two *Neighbouring*

Points, scarce make any confusion in their *Actings*.

VI. *Urinator* or *Diver* see *Objects* confusedly in the bottom of the *Waters*, except they make use of very *Convex Glasses*.

The Reason is, because the *Rays* of *Light* are not sensibly broken when they pass from the *water* into the *aqueous* or *watry humour* of the *Eye*; and so those that proceed from the same point are not again compelled by falling into the *Retin Tunicle*, which may be gained by the use of very *Convex Glasses*.

Things presented to the *sight*, by how much the farther they are distant, so much the higher they appear, and on the contrary high things so much the lower.

The Reason is, because things near at hand emit those *Rays* which finite the superiour parts of the *Eye*, or *Retin Tunicle*; whereas things remote send forth those *Rays* which arrive at the inferiour region of the *Eye*; and when the *Objects* in the *Retin Tunicle* are form'd with an inverted *situation*, those must needs seem more deprest and low, these more sublime. On the contrary it happens, when we convert the *sight* of the *Eye* to things plac'd on high; for then those things which are at a greater distance seem lower, in so much that the utmost bound of *Heaven* appears as it were conterminous to the *Horizon*: Forasmuch as that part of the *Heaven* which is our *Vertical point*, affects the lowest part of the *Eye*, and the other parts emit *Rays*, so much the more sublime by how much the more remote they are; hence that appears the supream of all, and the rest are so much the more sublime, by how much the nearer they approach to the *Vertex*; and so much the more deprest and low, by how much the farther they recede from it.

Objects sometimes by the contraction of the *Pupil* or *Apple* of the *Eye* are hidden to the *sight*, as if any one should direct his *sight* to some remarkable *Star*, for example, *Venus* or *Jove*, and by some Art should contract the *Pupil* of the *Eye*, the *Star* at first seen will by degrees disappear, and at length totally fly the *sight*.

The Reason of this is drawn from part of the said *Pupil*, which according to the rate of the said *coarctation* or *dilatation*, causes the *Object* to be seen, or to fly the *sight*: For since upon the contraction of the *Pupil* it receives fewer *Rays* under a smaller *angle*, it causes the *Object* to appear less, and consequently if they are so few as to be comprehended in an insensible *angle*, they will no way affect the *Retin Tunicle*, so far as is required to *Vision*; and as that affection is not perceived, so neither will the *Object* which ought to be perceived by the mediation thereof, be any farther apprehended. For it conduces to the rendring of that *affection* insensible, that in the contraction of the *Pupil*, the *ChrySTALLIN Humour* be somewhat relaxt; whence it comes to pass, that the bottom of the *Retin Tunicle* goes back so little, and becomes more weak by the incidence of the *Elapsed Rays*; which two things are sufficient to make the *Object*, at the contraction of the *Pupil*, to disappear, and what was seen before, to become afterwards invisible.

Hence

VI. These that dive into the water, see Objects only confusedly.

VII. How low Objects come to seem high, and high, low.

VIII. Objects ceasing to be seen when the Pupil is contracted.

IX.
How the
Stars come
to appear
bigger by
Night, and
lesser by
Day.

Hence it is that the *Stars* appear lesser by *Day* than by *Night*, when our *Hemisphere* is overlaid with *darkness*, namely by reason of the *Pupil* in the *light*, and the expansion of it when it is *dark*. For it is certain, that the *Pupil*, when ever *light* takes place, is rendred more narrow, and consequently that fewer *Rays* from a *flame* of *Fire* enter the *Eyes*, and that a lesser portion of the *Retin Tunicle* is affected; but the *Air* being overspread with *darkness*, it plainly appears that the *Pupil* is dilated, and consequently that many more *Rays* arrive at the *Eye*, and that a greater portion of the *Retin Tunicle* being affected, a greater *species* also of the *Object* is produc'd therein. Hence also it comes to pass, that the magnitude of the *Stars* seems in the *Evening* to *increase*, and so in the *Morning* to *decrease*; by reason that the *Pupil* in the *Evening* Season is by little and little dilated, and in the *Morning* by little and little contracted, and by this means the *Retin Tunicle* is ever less and less affected. So the *flame* of a *Candle*, if by *Day* it be beheld a hundred paces off, it appears very small, but upon the coming on of the *Evening*, it began to grow bigger, till *Night* at length increased it to the appearance of a considerable *Torch*.

X.
How some
Men discern
Objects
at a very
great distance.

It is reported of *STRABO*, that he was of so sharp and quick an *Eyesight*, that he could discern *Fleets* setting *Sail* from out of *Lilybaeum*, a Port of the *Carthaginians*, at the distance of above a hundred miles: Moreover, *LOPEZ*, a *Spaniard* at *Gades*, is related to have been able to discern from the top of the *Mountain Calpe* on the *European* side, to the opposite Shore of *Africa*, over the whole *Bay* between, which by the Testimony of *Cleonardus* in his *Epistle* to *Jacob Laboc*, is in a *Calm Sea* no less than three or four hours *sail*, and that so distinctly, that he could relate many things he saw there done.

This so wonderful a sharpness of *sight* depends mainly upon a double disposition of the *Persons* so indued, first from the docility of the *Chrystallin Humour*, and the easie use of the *Ciliary Processes*; namely, whilst according to the different incidence of *Rays* reflected from the *Objects*, the *Chrystallin Humour* is in such a manner adapted and disposed as an exact projection requires. 2dly, It is necessary that the *Capillaments* of the *Retin Tunicle* be so exquisitely disposed, as to receive the least affection. Because altho' those things which we behold with our *Eyes* cannot be discerned, but so far as in some sort they differ in colour, yet a distinct perception of *Colours* proceeds not only in this, that all the *Rays* proceeding from all points of *Bodies* meet in the bottom of the *Eye*, in so many other *Rays*, or thereabout; but also from the multitude of the *Capillaments* of the *Optick Nerve*, whose extremities are contain'd in that space which the *Image* in the bottom of the *Eye* possesses. Whence no doubt is to be made but *STRABO* and that *Spanish* *LOPEZ* enjoy'd so accurate a *texture* of the *Retin Tunicle*, and had so docile a *Chrystallin Humour*, that they were able to contemplate *Objects* more distinctly than others, and have a prospect of them at so vast a distance.

From this very cause it happens, that some *Men*, like *Owls*, see even in the darkest *Night*, as it is related of the Emperour *NERO* and others, namely, that they have most slender and very moveable *Fibres*, of which their *Optick Nerves* are framed; so that that little *Light* which remains in the most obscure *Nights*, suffices to affect their *Fibres*, and to excite the sense of seeing in them.

If a *Stick* fired at the end be swiftly whirl'd about, there will appear to our sight the *Image* of a *fiery Circle*, tho' the *Stick* be not in all points of the *Circle*.

The Reason hereof is, because the *Stick* makes an impression in those parts of the *Retin Tunicle* which are circularly disposed; so as that the foreparts being agitated by the celerity of the motion, still retain something of its impression, whilst it agitates the last parts. For this motion is not at one and the same individual time, but in divers successions of Moments, so swiftly performed, that the *Vibration* of *Fire* impress'd upon the *Eye*, remains in the first parts of the *Retin Tunicle*, when the *Stick* hath declined to the other parts of the *Circle*. When no wonder if the *Rays* entering the *Eye* by the *Pupil*, oft-times effect at once a sensation of *Greenness*, *Redness*, *Blackness*, *Whiteness*, and other *Colours*; because the *Rays* modified by divers *Colours*, in divers successions of Motions following each other with incredible swiftness, hit upon the *Retin Tunicle*, and leave a little while their agitation, till other *Rays* presently entering the *Pupil*, impart in their turn their motion, and there leave it some time with others.

Those that have a *Cataract Couch'd*, discern but obscurely all visible *Objects*; whereupon that they may the more clearly and distinctly see them, they make use of *Convex Glasses*.

To make this the more clear and evident, we must observe, that a *Cataract* is not any *Skin* (as hath been long believed) growing between the *Chrystallin Humour* and the *Uveous Tunicle*, which may be taken off by a *Needle*, and drawn down to the inferiour part of the *Eye*, but that it is the *Chrystallin Humour* it self, which in tract of time grows flaccid and weak, and is separated from the *Ciliary processes*, as an *Acorn* when ripe, is easily separated from its *Cup*, forasmuch as it is removed with little or no trouble, and deprest to the very bottom of the *Vitreous* or *Glassy Humour*, a small part, in the mean time, of the said *Vitreous Humour* succeeding in its place. The *Cataract* therefore being thus taken away, the *Chrystallin Humour* also must of necessity be taken away, or at least be rendred more plain, or less convex, whereby it comes to pass that the *Rays* proceeding from all points of the *Object*, are not sufficiently broken or made bending, so as to be united in the *Retin*, when they arrive there: Whence the *Vision* or act of *Sight* must needs be confus'd. To which infirmity the *Chrystallin Convexity* only gives relief, as causing the *Rays* which before were divergent to become convergent, and to enter the *Eye* with such a disposition.

Upon sight of the *Sun*, or any other *Glaring Light*, we seem to behold various *Colours*.

XI.
How it is
that some
Men see by
Night.

XII.
How a Body
appears
where it is
not.

XIII.
How it is
that they
who have a
Cataract
couch'd, see
obscurely.

XIV.
Divers Colours
appear upon
sight of the
Sun.

The

The Reason is, because such is the nature of our *Mind*, as by virtue of the *motions* that occur in that part of the *Brain* whence the tender *Filaments* of the *Optick Nerves* proceed, to be capable of having a *Sense* of *Colour*; whereupon in regard the *Agitation* by which, after the *Eyes* shut, the *Capillaments* of the *Optick Nerve* still palpitate, and as it were tremble, is not strong enough to render the *Light* so bright, as that was from whence it came, it represents *Colours* less intense, and as it were dilute; but that these *Colours* are produc'd from motion, may from hence be easily concluded, namely that growing pale by little and little, they are changed, and passing mutually into each other, vanish by degrees.

XV.
How it comes that the top of a Mountain far distant seems contiguous to the Horizon.

The top of a *Mountain* reaching far beyond the visible *Horizon*, appears to us as joined with it, together with the *Hill* it self, and the *Sun* when it rises or sets seems to adhere to, and be united with the said *Horizon*.

The Reason of this appearance is, because things appear at no distance from us, when the *Rays* cohere, and without the interposition of other *Bodies* apply to our *Eyes*; as it happens in the forementioned case: Forasmuch as tho' there is a vast distance between the *Sun* and the *Horizon*, and many *Bodies* are contain'd therein, yet because none of those *Rays* arrive at us, but only from the *Sun* and the *Horizon*, it happens that they seem among themselves contiguous and cohering. For the distance of the *Horizon* is no other ways known by us, than from the diversity of *Bodies* interpos'd between us and them; whence if those intermediate spaces should happen to be obstructed, and nothing of them could possibly be transmitted to us, we must needs judge those things which we see afar off, to be contiguous and separated by no interval. Wherefore GASENDUS thinks that *Dogs* bark at the *Moon*, because they apprehend it to rise near the *House* top, and so to be very little more distant than the *House* it self, and not much bigger than that part of the *House* comprehended by it.

XVI.
Ditches from a low place appear joined together.

So if we behold many *Ditches*, the sides of them plainly appear to us as not much distant from each other, because they are represented to us by *Rays* from the *Eye*, to which many also that slide from the bottom, mingling themselves, are carried upward; but if we behold those *Ditches* *Horizontally*, or from a low place, their sides seem to us to have no distance at all, because no *Rays* proceeding from the bottom, reach the *Eye*, and those which proceed from the sides, stick as they arrive.

XVII.
Why Drunken Men see double.

Drunken Men see every Object double, which VIRGIL asserts also of *Mad Men*. 4 *Æneid*.

This proceeds from the dark and malignant *Vapours*, either flowing from the *Wine*, or stirred up by the malignity of the *Distemper*, which while they pervert the situation of the *Optick Nerves*, they make such a percussion of the *Brain* at the same time, as if the *Rays* exhaling from the Objects, proceeded from detorted *Eyes*: Whence those that by *Nature*, or any chance or accident, have their *Eyes* drawn awry, see all things double.

We find by daily experience, that standing in the dark, we plainly see things put in a light place, but not on the contrary, from a light place things set in the dark.

The Reason is, because the *Rays* of *Light* may be directed to the *Eye*, being in a misty or dark place, that some of them may make their way into the said obscure place, if the passage be open enough, and the *Light* gliding through it into the *Pupil* of the *Beholder*, arrive as far as the *Retin Tunicle*. But he who is in the midst of the *Light*, cannot apprehend those things which are in an obscure place, because from thence no *Rays* proceed, which either directly or by reflection can touch the *Retin Tunicle*; unless by chance the *darkness* be some way or other intermingled, and remit some *Rays* of *Light*; for then nothing would hinder, but that a few *Rays* reflect from things would sensibly affect the *Eye*, and represent some sort of *Image* of things.

The *Hyperboreans* or *Inhabitants* of the most Northern Countries, have generally bad *Eyes*, and are dim-sighted.

The Reason is, because they are perpetually conversant in *Snow*, which above all things reflects back the *Light*, by reason whereof their *Eyes* must needs be strain'd, or because their *Retin Tunicle*, hardned by the external brightness, is less capable of expressing, or entertaining an affection necessary for *Sight*. When as we see that the *ChrySTALLIN Humour* becomes congealed with cold, and attains to such a rigidity or stiffness, that it can neither be bent, nor contracted, nor unfolded.

A Cannon Bullet, or any dark Body, passing with incredible swiftness through a whitened Wall, becomes altogether imperceptible.

The Reason is, because the dark Body, as likewise that so rapidly moved, making no impression upon the *Eyes*, so lightly, at that time, interrupts the reflection of the *Rays* of *Light* from the *Wall*, that the *Eye*, for that small interval of time, preserves the commotion which those *Rays* immediately before produc'd. The contrary whereof we find by experience in a *Firebrand* whirl'd round, in regard the *Brand* impresses its force upon the parts of the *Retin Tunicle* formed into a round, because then the rapidity of the motion causes the part first moved to keep yet a little while that impression which the *Brand* makes upon the last.

Those that have prominent or Goggle Eyes, as the *Myopes* or *Purblind People*, see not Objects distinctly at any great distance.

The Reason is, because the *Rays* of *Light* driven and refracted upon the prominent *Eyes*, meet sooner than they can arrive at the bottom of the *Eye*; Forasmuch as they represent the *Image*, not in the *Retin Tunicle*, but on this side; namely in the *Vitreous Humour*. Wherefore Goggle-eyed Persons are wont to make use of *Prospective Glasses*, because by them the *Rays* are divided, and do not so soon concur and meet together.

An Object in a plain Glass appears just as big as it is, but in a *Convex*, less; and in a *Concave*, greater.

The Reason is, because a plain Glass remits towards the *Eye* all the *Rays* from each direct point of the Object, and thereby every thing must needs be

XVIII.
Why we see from the dark, things set in the light

XIX.
The Hyperboreans have generally very weak Eyes.

XX.
Bodies moved with a rapid swiftness are not perceived.

XXI.
Why Goggle-eyed Persons cannot see clearly at any great distance.

XXII.
The Object is varied according as it is represented in divers Glasses.

be represented just as big as it is. Whereas the *Convex*, by reason of the obliquity of the incidence, diversly disperses this way and that way a great part of the *Rays*; whence it is that few of them are directed into the *Sensarium*; and on the contrary, the *Concave* not only remits to the *Eye* the *Rays* which are reflected from the *plain*, but also very many more, which come from the little devexitated regions of *particles*, and those of *points* also elsewhere obverted. Whence it comes to pass, that the *Figure* is increas'd, and exceeds in magnitude the represented *Object*.

XXIII.

Why some Men see nothing, but at some certain distance.

Some *Men* perceive not *Objects*, except at some certain distance, in so much that either very near, or very far off, they see but confusedly.

The Cause hereof is chiefly custom, as when *Men* use themselves to look at such a distance; for the *Muscles* which are disposed to the immutation of *Figure*, are rendred as it were stupid, and unapt for their wonted *functions*; not otherwise than the rest of the *Muscles* of the *Body* become unuseful for the motion of the *Members*, after they have stood long unmoved. To which may be added, that the *Membrans* which contain the three *Humours* of the *Eye*, may possibly have become so hard, as not to be so flexible as formerly.

XXIV.

How a Blindman saw a little, by compressing his Eye.

A certain *Young Man* being *blind*, while he prest either *Eye* towards his *Nose* with his *Finger*, could see a little, otherwise nothing at all.

Possibly this might be, because by the said compressing of the *Eye*, he inverted the convexity of the *ChrySTALLIN* or *Uveous Humour*; whence followed a change of the *Projection*, and consequently another *Affection*. In like manner as when holding to our *Eyes* a *Leaf* of a *Book* printed in a very small *Character*, we keep one *Eye* shut, and prest the other down with two *Fingers*, we shall fancy the *Letters* to be increased, and become bigger.

XXV.

Why the whole Sun cannot be seen in an Optick Tube.

The whole *Discus* of the *Sun* cannot be seen by the help of an *Optick Tube*, tho' the whole *Image* be projected upon an opposite sheet of *Paper*.

The Cause hereof is, by reason that the *Optick Tube*, in respect of its *Cavity*, divides the many *Rays*, and suffers them not to fall into the *Eye*; whereas all the *Rays* of the *Sun* fall upon the *Paper*, and form therein a far more large *Effigies* of the *Sun*.

XXVI.

Vision is made much more distinct, by a hole made by a Needle in a Card or Paper.

An *Object* which appears confused, as being too near the *Eye*, may be seen distinctly enough at the same distance, by any one through a hole made with a *Needle* in a thin *Card* or piece of *Writing Paper*.

The Reason is, because the *Eye*, then receiving a lesser quantity of *Rays* from every point of the *Object*, each of them forms its *Image*, even in a very narrow space; so that those which proceed from the two *Neighbouring points* scarcely confound their *actions*.

XXVII.

How a Stone at the bottom of a Vessel comes to be seen by the pouring in of Water.

If any one putting a *Stone* or *Counter* into a *Vessel*, so place it, that he can no longer discern it, yet by pouring *water* into the *Vessel*, directing his *Eye* precisely to the same place, he will see the *Counter* or *Pebble* sticking at the bottom of the *Vessel*, tho' it did not appear there before.

To this there can be assigned no other Cause, than that the *Rays* reflected before from the *Counter*, there being then no sort of *Body* interposed between, were directly sent into the *Air*, and by consequence smote nothing but the *Forefront*, and neighbouring parts of the *Eye*: But upon the infusion of the *Water*, the *Beams* passing through it, are refracted, and so applying towards the *Eye*, render the *Stone* visible and conspicuous thereunto. Thus we see in the *refraction* of the *Rays* made in the *Horizon*, the *Sun* being 34 minutes high or thereabouts, appears much higher to us, than it would appear, if those *Vapours* were absent, through which the *Rays* of *Light* are transmitted, and consequently being half a degree and 30 minutes diameter, it may be all seen, tho' deprest and wholly underneath the *Diameter*.

Things appear bigger than they really are, through a *Convex Chrystal Round*: As we find by experience in old *Men*, who being not able to discern *Letters*, tho' near at hand, help their sight in reading, by using the *Convex Glasses* of a pair of *Spectacles*: As also in those that make use of *Microscope Glasses*, for the viewing and discerning of the *Hairs* of a *Flea*, and even the minutest and smallest *Bodies* imaginable.

The Reason is, because in a *Convex Glass* plac'd between the visible *Objects* and the *Eye*, the *Rays* which before came short, and hardly reach'd the *Ball* of the *Eye*, are forc'd into the *Pupil*, so that the *Eye* receives the *Rays* from the *particles* of the *Objects* formerly hid; and since the *Rays* before join'd with them are separated from those interposed, and many *particles* seen from each part, they must needs be thereby enlarged, and represent the whole bigger. For when the *angle* is increas'd, the visible *Object* coming next in view, by reason of the great divarication of the *Rays* entring cross-ways the *Pupil* of the *Eye* toward the *Retin Tunicle*, must needs form a great *Image* in the bottom of the *Eye*.

Hence it comes to pass, that through a *Telescope* or *Optick Tube*, we see things at a good distance, in their full *magnitude*, and discern them very distinctly. For this advantage a *Telescope* brings, that it causes the visible *Object*, by reason of the great *Pupil* of the *Tube* to be discerned with more *Rays*, and by reason of the convexity of the utmost *Glass* gathering the *Rays* under a greater *angle* of *Vision*. Moreover the divarication becomes great, of those *Rays*, which entring cross-ways the *Pupil* or utmost extremity of the *Tube*, towards the *Retin Tunicle* of the *Eye*, cause a large *Image* of the visible *Object* to be described in the bottom of the *Eye*.

The *Object* appears singular, or but one, tho' transmitted to the *Brain* through both *Eyes*; and tho' the *Optick Nerves* meet not in conjunction, as appeared in the dissection of a certain *Young Man*, in which *VESALIUS* found them to be separate or divided.

The Reason of the simplicity of *Objects* is referred to the *Conarion* or *Pineal Glandule*, situate in the midst of the *Brain*, in which the two *Images*, which proceed from the two *Eyes*, are united before they arrive at the *Soul*. For there is no other part in the *Brain* which is not double. For as for the *Cerebellum*, except in superficies and name, it is not one: Nay, it is manifest that its

7 R.

Ver.

XXVIII.

How things viewed through a Convex Chrystal Glass appear.

XXIX.

Through a Telescope things appear greater.

XXX.

Why from two Eyes any Object appears singular.

Vermiformous or *Worm-formed Proceſs*, and the *Marrow* of the *Spina Dorſi* conſiſts of four parts; two whereof proceed from the two *Medieties* of the *Brain*; the other two from the two *Medieties* of the *Cerebel*: But the transparent *Septum*, or *Fence* which ſeparates the two formoſt *Ventricles* is alſo double, and conſequently that *Pineal Glandule* only is ſingle, in which the *Species* proceeding from both *Eyes* may meet, before they are conveyed to the *Soul*.

XXXI.
Why the
Picture of
a Man
ſeems to
look upon
all Perſons
in the
Room.

A *Painted Perſon* ſeems to caſt an *Eye* upon every part round about him, and as it were to look upon every one in the *Room* particularly.

The *Reason* hereof is, that the *Eye* of the *Picture* is in plain, and conſequently the *Rays* may be brought from all its points to the *Eye* of the *Beholder*. But the *Eye* of the *Living Perſon* being of a *Convex Figure*, and a great part of it hid, it is not able to ſend out its *Rays* every way, as we find apparent in *Carved Images*, whoſe *Eyes* being exerted or ſticking out, and ſhap'd into a certain *Curvity* or *Convexity*, cannot emit the *Rays* every way.

CHAP. VI.

Of Imagination.

I.
Whence
arife the
diverſity of
Wit and
Imagina-
tion.

ALMOST all *Men* differ ſome way or other in *Wit*, and *Imagination*.

This chiefly proceeds from the various *Conformation*, *Figure* and *Magnitude* of the *Brain*, *Texture* of parts, *ſubſtance* and *motion* of *Animal Spirits*. For all theſe things very greatly conduce to the quickneſs or ſlowneſs of *Wit* and *Imagination*. For as much as if the bulk of the *Brain* be either leſſer or bigger than is fit, the *Wit* will either be precipitate or ſlow; either becauſe the *Spirits* themſelves have not a paſſage free and open enough, or becauſe the equal motion of them is put out of order through the default of the *Figure*; or perhaps becauſe in a larger bulk the *Contexture* of the *minute parts* is coarſer, or there is ſome other more occult *Cauſe*, which repreſents the *Images* of things diſtorted or ill delineated.

II.
Whence
proceeds
the vari-
ous Inclina-
tions of
Men, ſome
to one Art
or Science,
ſome to
another.

Whence according to the various degrees of *Imagination*, *Men* are variously carried by a certain innate *Inclination*, ſome to the *Mathematical Arts*, others to *Eloquence* and *Poetry*, others to the *Art of Medicine*, that is, the *Practice*; for the *ſpeculation* thereof, which comprehends the *Principles* and *Rules* of *Medicine* more properly relates to the *Intellect* or *Underſtanding*; as the *Practick Part* of it which examines all the *Indications* and *Circumſtances* of a *Disease*, and takes opportunities of *healing*, belongs chiefly to the *Imagination*: Whence it happens that the moſt learned and acute *Phyſicians* are not always the moſt happy in curing of *Diseases*. The ſame thing is for the moſt part obſervable in other *Sciences*: For thoſe *Men* who are the moſt *Learned* and *Skilful* in the *Law*, are judged the leaſt fit for other *Civil Employments*.

III.
Many
things oc-
cur to our
Imagina-
tion, which
never of-

Many things, through our inadvertency, occur, which before were never offered to our *Senſes*, nor left any *Vesti- gium* of themſelves; as when, for Example, we conceive in our *Imagination* a *Hippocentaur*, and other *Chimara's*, which neve-

presented themſelves to our *Eyes*, ſuch as we form'd them in our *Fancy*.

But tho' perchance thoſe things which we conceive in our *Imagination*, were not before in our *Senſes*, as to their *Composition*; nevertheless it cannot be doubted, but that the parts of which they were conſtituted, have at ſome time or other entred the *Brain*; or if haply not by themſelves, yet by ſome other thing which had a great affinity with them. For if a *Horse* and a *Man*, for example, be repreſented to our *Eyes*, and the *Species* of both be impreſt upon the *Organ* of *Imagination*, we eaſily compound them together, and conceive a *Hippocentaur* or *Animal*, conſiſting of *Man* and *Horse*. In like manner we may determin of the *veſtigia* of other *Objects*, by the *ſight* whereof we form many things which before fell not under our *Senſes*.

They who, not being ſo accuſtomed, paſs over high *Bridges*, or from a high *Tower* caſt their *Eyes* upon the *ground*, are commonly taken with a *Vertigo*, and fancy all viſible *Objects* to turn round.

This proceeds from *Imagination*, which apprehends danger from the ſituation or poſture of the *Body*, and dreads the hapning of any miſchief to it, whence being very cautious how it tranſmits the *Spirits* into the *Nerves*, and how to direct them more ſecurely, it recalls them into the *Medullium* or *inmoſt part* of the *Brain*, and ſo perverts them from their accuſtomed *afflux* and *Irradiation*; and while it indeavours to direct them into better order, overmuch ſollicitude compels them into a certain conſuſion and irregular motion. And for this very *Reason* it is, that bold Perſons, and *Men in Drink*, in regard they take little care of the *Regimen* or *Government* of the *Animal Spirits*, ſuffer no ſuch *Vertigo*.

Some *Men* ſeiſed with a *Disease*, eſpecially thoſe in a *Fever*, fancy they do or ſuffer many things which indeed they do not: For I have known one in a *Tertian Ague* often complaining that he was grievouſly afflicted with a *wound* in his *Shoulder*, when at the ſame time he had in reality no *wound* at all.

This happens by reaſon that the *Species* which are impreſt by the courſe of the *Spirits*, or raiſed by means of the *Vesti- gia* of the *Memory* are equally vivacious, and indued with no leſs ſtrength than thoſe which proceed from the *Senſes*. For when at that time the *Animal Spirits* are agitated above what health requires, they concur with the *Vesti- gia* of the *memory* to the creation of other *Species*, which repreſent all things to us as being without us, and preſent to our *Senſes*. It alſo happens ſometimes in a *Disease*, that *Objects* make no impreſſion with which the *Mind* can compare thoſe *Species*, which the *memory*, or the force of the *Spirits* there ingender.

Thus it is probable that *Witches*, buried in a deep ſleep, imagine they ſee *Places* far remote, *Towns*, *Cities*, *Palaces*, *Troops* of *Men* and *Women*, &c. and being awake deſcribe them to a title, as if they had ſeen them with their *Eyes*. Which doubtleſs is done by the help of the *Devil*, who repreſents the *Ideas* of thoſe things to their *Imagination*, and ſo ſtrongly imprints it in them, that they make no manner of doubt but that they were preſent at thoſe ſorts of *Shows*.

fer'd them-
ſelves to
our *Senſes*.

IV.
Why thoſe
that look
upon the
ground
from any
high place,
are taken
with a *Ver-
tigo*.

V.
Why Men
in a *Fever*
fancy they
ſuffer theſe
things
which they
really do
not.

VI.
Witches in
Imagina-
tion, ſee
places far
remote.

Some





VII.
What the
cause is of
marks im-
printed in
Births.

Some *Marks* or *Characters* are imprinted in *Births* by the force of the *Mother's Imagination*; this appears in *Mothers* that long for any thing: For upon their touching of the *Cheek*, or any other part of the *Body*, the thing so earnestly coveted, for example, a *Cherry*, *Grape*, or whatever else it be, is commonly impress'd in the same member. And *FORESTUS* makes mention of a certain *Noble Woman*, who, whilst she was with *Child*, having broke her *Arm*, brought forth a *Male Child* with a broken *Arm*.

The Reason hereof is, that the *Image* of the *Cherry* or *Grape* imprinted in the *Brain* of the *Parent*, is conveyed by the motion of the *Spirits* to the *Infant*, by reason that the same disposition which inheres in the *Mother's Brain*, and moves in her the desire of the said *Fruit*, passes also into the *Brain* of the *Infant*, corresponding to the part affected: Whence the *Mother* touching her self in that part, in the time of her longing, produces there the effect of her *Imagination*. Because the *Mother* thus touching her self, there comes presently into her mind, the figure of the *Image* to be imprinted on the *Birth*; from whence a motion of some kind of shame, and also fear arises; without both which no mark is ever imprinted in the *Bodies* of any *Infants*. So also for the other Instance: For since every one of the *Infants members* is answerable to every one of the *Parents*, and the *Fibres* and *Humours* of both are continuous, no wonder if the *Male Child* of the foresaid *Noble Woman* was born with a *Broken Arm*, and the same remedies being applied to the *Arms* of both *Mother* and *Infant*, both were separately cured.

VIII.
The power-
ful force of
Imagination.

To the same cause may be referred what happened to an *Apothecaries Wife* at *Bononia*, who being with *Child*, and seeing through a *Window* in a *Neighbours House*, *Snakes* flea'd, and hung to dry in the *Air*, brought forth a *Child* with a *Snakes Head*: So another *Woman* in *Sicily*, according to the Testimony of *ALDROVANDUS*, observing a *Lobster* or *Sea-Crab* taken by a *Fisherman*, and being taken with an earnest longing for it, brought forth, together with the *Birth*, a *Lobster* altogether like what she had seen and long'd for.

IX.
A Party-
Colour'd
Child
born of a
white Wo-
man.

Hereunto may be added another *History*, quoted by *JOHANNES SWAMMERDAMUS* in his *Treatise* entitled, *Uteri Muliebris Fabrica*, In which the force of *Imagination* in a *Woman* with *Child* is clearly demonstrated. A certain *Woman* of *Utrecht* being with *Child*, and going to a *Shop* to furnish her self with some things for her *Domestick Use*, upon her first entrance, sees a *Negro*, at which sight being affrighted, she went home, thinking no other but that she should bring forth a perfect *Black*. But at last recollecting her self, she borrows a remedy against this strong *Imagination*, from another equally strong, perswading her self that all the *Blackness* in her *Imagination* might be wash'd off with hot water; in order whereunto the kindles a *Fire*, heats a *Skillet* of *Water*, and washes her self all over from *Head* to *Foot*. What follows? The time of her *Delivery* arrives, the *Child* is born, hath all his *Teeth* entire, and appears a perfect *White*, those places excepted to which in the *Mother*, while she wash'd her self, the water reach'd not;

such as in the *Hands* and *Feet*, the *Interstices* or innermost parts of the *Fingers* and *Toes*, and some other parts of the *Body*, where there appeared manifest signs of blackness and black Spots.

PERSINA an *Ethiopian Queen*, beholding, in the midst of *Copulation*, the Picture of a *White Child*, brought forth a perfect *White*; and on the contrary, another *Queen* an *European*, on the like occasion, brought forth a *Negro Child*.

This some *Physicians* attribute to the *Seed*, which according to its various quality, induces various forms: So that if it be *Yellowish*, they will have it to produce a *Ruddy Colour*, if *Cineritious* or *Asbes-like*, a *Brown Colour*; if *whitish*, a *White*.

Which *Opinion*, tho' it be common, yet in this matter, *Imagination* must claim the principal part. Because in regard the *Nerves*, through which the courses of the *Spirits* are incessantly carried, are extended from the *Brain* into all parts of the *Body*; the force of *Imagination*, especially if it be a little more strong than ordinary, by operating upon the *Bowels*, and exciting the motions of the *Humours*, may very well induce a *Black* or *White*, or any other *Colour*. So *Jacob's Sheep*, according to the different aspect of the *Rods* set before them, brought forth their *Young* of a various *Colour*.

By the certainty of this conclusion, *HIPPOCRATES* cleared a *Woman* that lay under suspicion of *Adultery*, upon bringing forth a *Child* utterly unlike her *Husband*; finding that it was very like a *Picture* which hanging up in her *Bed-Chamber*, the said *Woman* look'd upon very steadfastly in the time of *Coition*. For the same Reason is to be excus'd that *Lady* of the *Noble Family* of the *Ursini*, who brought forth a *Male Child* like a *Hairy Bear*, because all the while she was big, she had very frequently before her *Eyes*, and consequently in her mind the *Pourtraictures* of *Bears*, which are the *Arms* of the *Ursini*.

Wherefore I judge nothing more blame-worthy among a sort of light and wanton *Women*, than the great delight they take in *Whelps*, young *Apes* and *Monkeys*, taking them up in their *Arms*, hugging, stroking, and continually handling them, since by this frequent having them in their *Laps* and *Sight*, they habituate their *Imagination* to I know not what strange and deformed *Ideas*, and so often bring forth a *Birth* that hath something of an odd, ill favoured sort of *Meen* in its *Countenance*. Wherefore I cannot but look upon it as very convenient that those sort of *Dogs*, vulgarly called *Camusii*, should be sent away, that the sight of them may not prejudice bigbellied *Women*, and be the occasion of deformed *Births*.

Such a kind of *madness* possesses the *Minds* of some *Men*, and so perverts their judgment, that in their discourse they have always one thing by the end, and neither give attention nor answer to the words of other *Men*. I saw a *Phrenetick* at *Paris*, who for a whole day together repeated the same words over and over again; and if by chance he was interrupted by any one, he would stare upon the *Person* so speaking to him, as it were intending to answer him word by word, but no sooner had the said *Person* done speaking to him, but he was at the same *Story* as before.

In such sort of *Men* it falls out, that so great a perturbation possesses the *Animal Spirits*, as to suffer the impression of other words to adhere to the

X.
How it
came to
pass that
an *Ethio-
pian Queen*
brought
forth a
White
Child.

XI.
Imagination
can perform
wonderful
things.

XII.
Deformed
Whelps are
so becom-
med from
the sight of
bigbellied
Women.

XIII.
Why some
delirant
Persons
have al-
ways the
same
discourse.

the *Glandule*, but a very little space, whereby it comes to pass, that the first *Image* of things by which it is detain'd, immediately returning, they (as having forgotten the words last said) are not able to give any answer to them, but only conformably to those things which impel the *Glandule*, and are at that time represented to their *Mind*. For I am apt to think that these sort of *Men* are not troubled with a *Phrensie*, but only so long as their *Soul* has no command over the motions of the *Glandule*; or because the *Animal Spirits* are in such commotion, and are carried above it with so unequal a course, that they shatter it without measure, and raise upon it innumerable species, which presently flow out and slip away. Or else, because the course of the *Spirits* imbues the *Glandule* with some *Vestigia* of *Memory* so tenaciously, that the same *Image* is always represented from which the *Soul* is not able to disengage it self.

XIV.
How it comes to pass that sometimes we are not sensible of things present.

In like manner some *Persons* are not sensible even of those very things which their *Organs* perform, as it happens when the *Soul* is wholly taken up or diverted by any strong thought, by reason that the *Animal Spirits* flow in so great a quantity through the tract upon which this thought depends, that those which remain are no longer able to supply the tract, which the Object present endeavours to impress. For which Reason it is, that those who are seiz'd with any acute pain, cannot possibly fix their thoughts upon any other thing but that.

XV.
Some Men are carried by their distemper to fancy themselves Kings.

Some imagine their *Nose* to be of so great a bulk, as not to be passable through any Door: Others believe themselves to be *Kings*, as that *Spanish Servant* whereof JOHANNES HUARTUS makes mention, who verily believing himself to be a *King*, made many grave and wise Discourses concerning Government. MONTANUS speaks of some who fancied the surface of the *World* to be made of *Fine Glass*, and that *Serpents* lay lurking every where underneath the said *Glass*; upon which conceit he kept his *Bed*, thinking himself there safe as in an *Island*, and that if he should stir out of it, he should break the *Glass* and so fall upon the *Serpents*.

The Reason of this extravagance may be drawn from what hath been said; for whilst by any tenacious disposition of the *Spirits*, and certain firm tracts of the *Memory*, the *Glandule* is converted to that part of the *Brain* where the pores are opened; by the opening whereof the *Species* of *King*, *Serpent*, *Glass*, &c. may be revolv'd, or else is form'd at that very time; the *Soul* beholding such a *Species*, considers it self as joined to that very *King*, *Serpent*, *Glass*, &c. which are represented by the said *Species*, and as it were a *Composition*, making together with it one whole. I knew one at *London*, who took upon him to be *Archbishop* of *Canterbury*, so created by the *King*, and undoubtedly ordained to succeed the present Incumbent in that *See*, when as at the same time in all other things he seemed to be a person sufficiently discreet and serious, and labouring under no other *Phantasm*; for he carefully minded his own affairs, spent his time seriously and wisely, and providently behaved himself in executing the *Imploy* he was engaged in: All which I suppose may well enough be if the agitation of the *Spirits*

by which the *Glandule* was formerly governed, ceases at that time, so long as nothing comes in its way that can renew those pristine motions, until the *Fit* returns, and a new access comes upon the persons affected as it were upon those that are subject to a feverish Distemper.

A certain *Person*, when by chance fell into a *Well*, where there were abundance of *Spawn* of *Frogs*, and taking into his *Body*, by the fall, some of the *Well-water*, he afterwards took a deep conceit, of his having young *Frogs* in his *Belly*, that he could not be otherwise persuaded for many years; in so much that for seven years together, he betook himself to the study of *Physick*, merely for the finding out of a Remedy for this supposed Distemper; moreover he travelled into *Italy*, *France* and *Germany* to consult the *Physicians* of those Parts concerning the said affair, still fancying that the rumbling of his *Guts* was the *Croaking* of *Frogs*, nor was he otherwise cur'd at last but by deception; forasmuch as a *Physician*, acting above others by policy, conveyed live *Frogs* into his *Excrement*, and so made him believe that he had voided them by *Stool*. And all this while, setting aside the recourse of this *Imagination*, if it did recur, in all other things he acted very prudently, and made not the least discovery of any extravagancy: Which might be, because the *Animal Spirits* ceased sometimes to flow through that tract of his *Imagination* where the extravagance was impress'd, as being diverted by some other occasions; so that he appeared discreet enough till such time, as upon the renewing of the cause, the access of his whimsical *Fit* returned, that is to say, till such time as some cause had disposed the *Animal Spirits* to the same course.

XVI.
Of one that imagined he had Frogs in his Guts.

CHAP. VII.

Of Memory.

AS *Men* differ in *Wit* and force of *Imagination*, so also in *Memory*. For some there are who presently get a thing by heart, and as soon forget it: Others get it soon, and firmly retain it: Others are slow in getting a thing into their *Memory*, yet when once gotten they do not easily lose it. Lastly there are who slowly learn a thing, but forget it soon.

I.
How it comes to pass that Men differ in Memory.

As to the first sort, they are *Men* who have nervous *Fibrils* sufficiently thin and flexible, so that they easily receive the Impressions of the Objects, so that their *memory* soon gets hold of any thing; but then on the other side their *Brain* is too moist and diffused, so that the *Vestigia* of what they had gotten are quickly effac'd, and consequently they forget those things they had learn'd just before. As to those who suddenly get a thing, and also long retain it, they have a *Brain* most excellently well tempered, neither too moist, nor too dry, so that consequently the *Fibrils* are wonderfully flexible, and thereupon the *Vestigia* or tracts themselves, are not, as in the former case, so soon effaced; and these *Men* are of all others of the happiest temper. As to those that slowly learn any thing, but long retain it, they have thicker, stiffer and less flexible *Fibrils*, whence they difficultly receive the





the *Vestigia* of the *Objects*, but withall they have a *Brain* sufficiently temperate, in so much that the *Vestigia* being there once imprest, they remain there a long time; so that those sort of *Men* cannot easily forget a thing which their *memory* hath acquired. And as to those who quickly drop or let go what they have slowly acquired, It is to be imputed to this, that the *Fibrils* of their *Nerves* are thicker and less flexil, and their *Brain* likewise intemperate, at least either too moist or too dry; and these sort of *Men* are of all others, of the most unhappy temper.

II.
Why Infants are deficient in Memory.

Children and *Infants* are less indued with *memory*, and sooner forget those things which they have learn'd, than those who are more advanc'd in *years*, or have arriv'd to their middle *Age*.

The Reason is, because the *Memory* depends upon certain *Vestigia* or *Tracts* in the *Brain*, after that the *Species* of any thing hath been imprest upon it. Whence if it happens that any *parts* of the *Brain* are changed by accretion or diminution, those *Vestigia* must needs be all of them disturbed, and some of them vanish. But whereas *Children* are continually growing, and something of new substance always added to them, the *Pleats* in the *Brain* form'd by the transcurse of the *Animal Spirits* are easily perverted and lose their pristin Order; as the *Pleats* or *Folds* in *Paper* are easily effaced if any of them be worn, or any new substance be super-induc'd: To this may be added, that the *Brain* of *Children* is too soft and moist to retain tenaciously any thing committed to it. For tho' it easily receives things, yet it retains not any distinction of them one from another, being like nothing so much as *Mud* tempered with a great deal of *Water*.

III.
The Memory very prompt in Young Men.

The contrary happens in *Young Men*, who having a *Brain* very well tempered, that is, neither too moist nor too dry; have also their *Fibrils* more subtle and flexil; and hence it is that the impressions of *Objects* are more easily received in their *Brain*, and longer conserved; and hence it is that *Infants* are much more capable of new habits than those of riper *years*, by reason that having the *Nerves*, *Muscles* and the *Brain* more tender, the *Animal Spirits* might the more easily form their passages: Whence it comes to pass, that *Infants* endeavouring and labouring to *speak*, get, in time, so great a facility of expressing themselves, that they pronounce their *words* with an incredible swiftness.

IV.
Some easily learn the things they hear.

Some *Persons* learn *Tunes* with little or no trouble, and afterwards without any study or labour of the *Brain*, express them, so as to make true and exact *Harmony*.

This so happens by reason that the *Animal Spirits* acting within the *Brain* from the distinct accents of the *harmony* heard, are disposed into peculiar *divisions*, according to which, when they flow into the process of the *Auditory Nerve*, like *Automata*, as it were spontaneously, and by a certain succession of *species* they easily express the *Tunes* of the *Voice*; or *Instrument* which they had taken in with their *Ears*. So *Musicians*, tho' intent upon other *affairs*, yet nevertheless can so guide their *Fingers* to find out the *Musical Stops* formerly taught them, that they touch the *Instrument* plaid on with wonderful skill, dexterity and sweetness.

The *Smoke* of *Tobacco* getting up into the *Brain*, weakens the *Memory*, and causeth *stupidity* and *dulness*, an excellent example whereof we have had in a *Person* of extraordinary Learning and Ingenuity, and once endowed with an excellent *Memory*.

V.
The Memory of a certain Learned Man, hurt by taking Tobacco.

And this might very well happen from the *Corpuscles* of the fume suck'd in, which entering the *Brain*, obstructed those *Vestigia* which represent the *Images* of *Things*, and consequently rendred them incapable of recalling any thing to *Mind*. Yet the said *Fume* being exhaled and drawn out, he recovered his former faculty, and called to *mind* many things which he had formerly known; much after the Nature of an *Apoplexy*, by which the *Blood* being effused out of its *Vessels* into the substance of the *Brain*, utterly obliterates the *Idea* of all things formerly known, no *Vestigia* of them remaining in the *Brain*.

Old Men, when they arrive to their decrepit *Age*, are almost totally develt of their *Memory*, and scarcely remember any thing which they did but a little before. Yet at the same time remember the *Actions* of their *Youth*, retaining them firmly in *memory*.

VI.
Old Men, tho' they easily forget what they did but a little before, yet firmly remember all the actions of their Youth.

The Reason why *Memory* decays in *Old Men* is, because of the over-dryness of the *Brain*. For dry things cannot be easily wrought upon, so as to be able to receive *impression*; or if they do admit of an entrance or impression, they soon return to their pristin state, and recover their former dispositions. But *Old Men* retain those things which they have received into their *Memory* a long time since, because the parts of the *Brain* are hardened, and its pores in which the *Spirits* formerly ran up and down, have acquired a certain facility of opening themselves in the same manner at the presence of any *object* upon the *Spirits* repairing to them. Hence it is, that they highly extol the times past, because they have a remembrance of things done heretofore, but presently forget late actions and occurrences.

Some *Persons* willing to supply this natural defect of the *Memory*, have invented a way of *Artificial Memory*; as thus, having hired a *Chamber*, they hang upon the Walls thereof several *Pictures*, to each of which they apply their *Cogitations*, and afterwards when they have sufficiently exercised themselves in uniting certain thoughts with certain figures, they make use of this their *Artificial Memory*, as they grow older and older, thus habituating themselves to recall this or that thing again into their *Memory*, according as they contemplate this or that *Picture*. For they cannot look on the said *Picture*, but presently there is excited in them that very thought which they had formerly join'd with the said *Picture*: For those things which are once joined in the *Mind*, remain joined there for ever.

VII.
How Artificial Memory may be obtain'd.

Hence if any thing that we knew before slip out of the *memory*, and we call it afterwards to *mind*, that thing also presently occurs which was joined with it. So that if any particular *Man* comes into our remembrance, we also call to mind the injury we have received, if we have received any from him.

VIII.
Why we cannot remember one thing without another to which it was join'd.

The Reason is, because when the *Vestigia* of the *Memory* have brought the *Image* of any thing upon the *Glandule*, the *Spirits* in like manner return-

returning through the same pores, bring back also another Species to which the former was joined; whereby it comes to pass, that the Spirits flowing into the same Muscles, dispose our Body to put forth the same actions again, which it put forth upon occasion of the Object which first excited them, and this by experience we find to happen not only in Man, but also in Beasts; for if we receive with a good Cudgel, a Dog ready to fly upon us, and so put him to flight, the said Dog, if we afterwards meet him, tho' without any Weapon, will as soon avoid us, as if armed; because by the means of the blows wherewith he was formerly entertain'd, the course of the Spirits which our aspect excites, becomes joined with that course which the Spirits produc'd. So that those two ways meeting in the Brain, and being confus'd into one, it matters not which of them opens to effect the motion of the Muscles, and excite the said actions.

IX.
Our Memory is more vigorous in the Morning than in the following part of the day.

Those Things which we revolve in our Mind in the Morning, we both more easily commit to memory, and more firmly retain, than whatsoever we think on the remaining part of the day.

The Reason is, because at that time the Brain is free, and not yet hindred by any Vestigia of things; for as in Paper a multitude of Pleits, and in the Air a great number of sounds brings confusion; so in the Brain the delineation of many things disturbs the Vestigia, and suffers them not to repose in their due places, nor to be perceived according to their proper nature. For the Sense being intent upon many things, is so much the more distracted and lessened, by how much the more it is employed in contemplating several distinct things. Add hereunto, that the Brain in the Morning is less hindred with Vapours, in regard the concoction of Meats being now finish'd, the Fibres thereupon are the more expedite, both for quickning the motions of the Brain, and putting on a new affection.

X.
Things seen are better remembered than things imagined.

We find always by experience, that we better remember those things which we have seen by a Corporal View, than what we have apprehended by the Eyes of Imagination; forasmuch as the Nerves which are the Organs of Sense, more invigorate the Brain, and impress in it deeper Vestigia or tracts than the Animal Spirits do which open the Vestigia of Imagination, and consequently we must of necessity more distinctly remember things seen, than things imagined; and for this reason it is that we know better the distribution of the Veins in the Liver upon the sight of one dissection of that part, than by reading it often times in a Book of Anatomy.

XI.
Some persons after a fit of Sickness, forget even the very Names of their Parents and Kindred.

A Fit of Sickness or Distemper sometimes takes away all Memory, and so weakens that faculty, that they who before were indowed with an excellent Memory, after the said Disease scarcely remember any thing. PLINY makes mention of one, who falling from a high place, totally forgot, during the remainder of his Life, the Names of his Parents, Friends and Kinsfolks. And MESSALA CORVINUS after a great fit of Sickness forgot not only the Names of his Relations and Domesticks, but even his own Name also. Moreover a certain Student of MARSEILLES, after a wound received, so utterly

lost his Memory, that he was forced to learn all over again, the first Rudiments of the Arts and Sciences.

The Reason is to be taken from the force of the Distemper or Blow given to the Head; which changes the disposition of the Brain, and perverts the pores formed by the means of the Spirits. Whence it comes to pass, that the Vestigia are expunged, or the contexture of the Fibres left in such a state, as renders it less apt for the foresaid Function. For as Liquor spilt upon Paper, washes out all its pleits or folds so utterly, that when the Paper is dry there are left no signs of them; so it may come to pass that the Morbifick Humour may so far prevail as to take away all the Pleits of the Brain, so that no Vestigia of them may remain which the Sick Man knew before. On the contrary, it may possibly happen, that they who before had a dull and heavy Memory, may from the same causes acquire a happy and lively one. As is related of Pope CLEMENT the Sixth, having so happy a Memory, that whatsoever he read he made absolutely his own, and never forgot it. The Cause of which Faculty PETRARCH ascribes to him from a wound given him in his Head, by which doubtless some Obstructions were dissolved, and the passages of the Brain opened, whereby a commodious way was made for the Spirits to pass to and fro. Another Person is mentioned by FULGOSUS, Lib. 1. Cap. 6. in the Reign of the Emperor Friderick the Sixth, who after breathing of a Vein, keeping his Memory intire in all other things, forgot to Read and Write as utterly as if he had never learnt either: But a year after, being let blood again, he recovered his knowledge of Reading and Writing, and became as it were a new Man.

In like manner it happens, that they who in Youth are brisk and active, when Age comes on, grow heavy and slow, and have little or no appearance of their former Wit and Ingenuity. Which proceeds either from the Blood vitiated, or from the Obstructions of the Brain, or from that Nervous Liquor, which being, according to the Modern Physicians, the Vehicle of the Animal Spirits, after too much Agitation or Evaporation grows flat. Hence oversoon ripe Wits which make such a clutter before their usual time, are not of long continuance, but in a short time decay and languish. Since such is the state of Nature, that those things which are best tempered, and to last a long time, are ripened by little and little; and as it were by degrees; so Summer Fruits soon decay, because the active principles of which they consist, quickly evaporate.

XII.
Why very soon ripe Wits soon decay.

CHAP. VIII.

Of Slumbers and Dreams.

Slumbers or reposes of Sleep are for the most part interrupted, and but seldom hold out continued.

This hence proceeds, namely, because the Spirits being diversly agitated, and finding the Vestigia of various impressions, direct their course through such pores, rather than others. For the Animal Spirits

1.
How Sleep comes to be interrupted.

Spirits running through the Pleits of the *Brain*, render the *series* of them in a manner inflate, and according to their various agitation, either move them with one single *motion*, or skip from one to the other. Hence if it happen, that the *Spirits*, leaving one *series* of the *Vestigia*, skip first into one, then another, and so forward, various *Imaginations* must of necessity arise, which hang together by no connexion one with another; and yet they are all of a Company, tho' with some small interruption. Whence ARISTOTLE compares such *Impressions*, as are formed by *Sleep* in the *Brain*, to *Frogs* made of *Cork*, which being stufed with *Salt*, are plunged into the *Water*, where as soon as the *Salt* is melted, they seem to struggle alternately, and without observing any Order, rise up to the surface of the *Water*.

ARISTOTLE in his Book of *Dreams*, Chapter the last, makes mention of some who are look'd upon as *Persons* that never *Dream'd*; such a one PLUTARCH mentions *Cleon* in his time to have been: And I my self was familiarly acquainted with a Doctor of *Physick* at *London*, who protested often times to me that he never had any apprehension of any thing in a *Dream*.

Altho' such sort of *Men* never remember that they *dream'd* of any thing, yet nevertheless they cannot be said to have been totally free from *Dreams*, for the *Soul* never wholly ceaseth from *Cogitation*; and whatsoever Body is laid asleep, that loses not its *Essence* which is constituted in *Cogitation*. So that because those sort of *Men* remember not that they had any *Nocturnal Cogitations*, it doth not therefore follow that they had none, since it many times happens to us not only to forget our *Dreams*, but even those *thoughts* which we had *waking*, altho' in the mean time we may be sufficiently assured that we saw in *Imagination*, or distinctly perceived something in our *Dream*: So *Cleon*, and those other *Persons* mentioned by *Aristotle*, were not free from *Dreams*, but forgetful of those things whose species were obliterated by reason of the quality of their temperament.

Some in their *Sleep* fancy such a load or weight lying upon them, as if some *Dæmon* lay heavy upon their *Breast*, and hindred the freedom of their *Breathing*. Hence this sort of suppression which the *Latins* call *Incubus*, is named by the *Greeks*, *Ephialtes* or *Insultor*, we call it in *English*, the *Night Mare*.

The Cause of this *Nocturnal Asthma* proceeds from the *Animal Spirits* being denied their influx into the *Nerves* and *Muscles* designed for the *Organs* of *Respiration*; for if in *Sleep* the *Animal Spirits* have not their free Influx into their *Muscles*, the like motion is induc'd; whence the *Soul* in such an affection judges according to Custom, as if some weight were incumbent, and hindred the motion of the *Diaphragma* or *Midriff*. Add hereunto that those things which come into our *Imagination*, when asleep or in a *Dream*, more strongly affect the *Brain* than those which are conveyed into it by the *Senses* when awake. So while we indulge to *Sleep*, if *Spittle* abound in the *Mouth*, it follows that we seem to chew some certain *Meats*, and to mast them with much Iteration, which never happens to us when we are awake. The same distemper may be caused when any

thick *Vapour* fills the *Womb*, which by reason of its thickness cannot evaporate; but by an excited heat diffends that part, whereupon the *Diaphragma* or *Midriff* is pressed, and therefore cannot be so commodiously drawn down, especially in the midst of *Sleep*, wherein by reason of the lesser influx of *Animal Spirits* it becomes less vehemently inflate, and is prest downward.

So the *Genital Humour* growing turgid in the *Spermatick Vessels*, and agitating them with a certain irritation procures unchast *Dreams*; so the more gross and undigestible sort of *meats* being taken at *Supper*, in regard they surcharge and lie heavy upon the *Stomach*, cause disturbances and frightful *Phantasms* in the *Sleep*.

It is usual with some persons to rise out of *Bed* at *Midnight*, and have recourse to those places and do those actions, which awake they would not dare to venture on; some hurry up and down, and without any help or assistance climb up *Trees*, and get up to *House-tops*. HORSTIUS makes mention of a certain *Nobleman*, who climbing up a *High Tower*, and ransacking the *Birds-Nests* there, got down again by the help of a *Rope*.

Physicians are of opinion that these things proceed from turgid *Blood*, and an Effervescence of the *Spirits*, which being carried into the seat of the *Mind*, agitate those *Instruments* of *Motion*, and impel them to perform those effects; whence it comes to pass, that the Body by the impulse of the *Animal Spirits* is wrapp'd up in *Imagination*, and by virtue thereof is incited to such actions: But I am of opinion, that all these things would signify nothing without the help of *Imagination* which in a manner alone performs and brings to pass all these difficult things. For *Imagination* is not only incited by *External Objects*, but also by those things which are represented in *Sleep*, whence being agitated by the reserved *Species* of things, it both excites extraordinary motions, and impels to the performance of those things which strike both admiration and astonishment into the *Beholders*.

It is reported of GALEN, that sometimes he walk'd almost a whole furlong in his *Sleep*; and of a *Servant* of *Pericles*, that he us'd frequently in his *Sleep* to walk upon the *House-top*. Others make mention of a *Schoolmaster*, who, in his *Sleep*, not only was wont to teach his *Scholars*, but went one time armed to kill a *Colleague* of his by whom he had been sharply reprov'd, of which when he wak'd he remembered not any thing. Moreover, some persons of undoubted credit have delivered a relation of two *Young Men*, whereof one tho' wholly ignorant of the Art of *Swimming*, yet us'd to rise in his *Sleep*, repair to the water and *Swim*; the other was also a *Night-walker*, who one time above the rest, went down into his *Masters Kitchen*, and there in presence, and to the admiration of some of the *Servants*, not yet gone to *Bed*, spitted the *Brooms* like joints of *Meat*, and laid them to the *Fire*; thus he bestirred himself, till at last waking, and being ashamed of what he had done he sneak'd away to *Bed* as fast as he could. And all these things proceeded from the height of *Imagination*, and the persons deeply fixing their *Minds*, each of them upon the things they acted, whereby the passages through which the *Animal Spirits*, first entred, remained so wide and open, that the same *Spirits* at length insinuated

IV.
The Cause
of unchast
Dreams.

V.
How it
comes to
pass that
some rise
out of their
Bed, and
walk in
their Sleep.

VI.
An Exam-
ple brought
of Galen
and others.

II.
Whether
there be any
that never
Dream.

III.
How the
Night Mare
comes upon
those that
are asleep.

VII.
Dreams
are usually
of those
things
which were
thought on
in the Day
time.

VIII.
How it
happens
that some
in their
Sleep let go
their water.

ated themselves; and the *Soul* by their motion became affected in like manner.

In *Dreams*, the same *employments* and *actions* run in our *Minds*, upon which we were intent and busied the day before.

The Reason is, because the parts of the *Brain*, which have formerly been shatter'd by the acting of an Inferior Object, are more easily moved by the *Animal Spirits*, than those which have always remained quiet; whence when the *Vestigia* of those things which we have first imagined, are discovered and remain after a sort laid open, the *Spirits* running slightly over them, bring back those *Images* of the *Soul* which it imprest upon it when awake. Wherefore unless the *Body* be indisposed and disturbed by *noxious Humours*, no other *Cogitations* can be offered to the *Mind* than those which possess it waking.

Some persons in their sleep emit their *Urin*, and as if they were standing against a *Wall*, or holding a *Chamberpot* in their hands make water.

This never happens but when the *Bladder* swells with fulness, and is extended beyond its usual extension, because then the *vellication* of the *Sphincter* so opens the *pores* in the *interiour superficies* of the *Ventricles* of the *Brain*, that the *Spirits* running to and fro above the *Glandule*, take their course toward those *Nerves* which are inservient to the emitting of the *Urin*, and thereby procure such a motion, that not only the appetite of making water is produc'd, but also the *Image* of the *Wall* or *Chamberpot* is presented, which they that thus dream were wont to make use of upon this occasion.

CHAP. IX.

Of the External Passions.

I.
Sanguine
Persons are
chiefly
prone to
Laughter.

MEN of a jolly Temper and sanguine Complexion, upon any the slightest occasion, burst forth into Laughter, nor are they, when any one else Laughs able to contain themselves, or when any matter of sport or merriment comes into their Mind.

This sort of Passion in Men of this Constitution arises from the moveableness of the *Fibres* which are stirred up, and as it were frisk at the occurrence of any sportive Object, by which affection drawn through the *Diaphragma* or *Midriff* a certain change of the Countenance with a sonorous and inarticulate Voice is created. For herein consists the reason of Laughter; that the Blood passing from the right Cavity of the Heart through the *Vena Arteriosa* suddenly, and with a repeated shaking, puffs up the *Lungs*, and causes the Air which they contain, to be compelled to break forth forcibly through the *Aspera Arteria*, in which it forms the *Inarticulate* and *Sonorous Voice*, and as well the *Lungs* by being inflate, as this Air by going out impel all the *Muscles* of the *Diaphragma*, *Breast* and *Throat*, by which means they move those *Muscles* of the Countenance that have any connexion with them. Wherefore no wonder if many times persons of great Sense and Ingenuity cannot contain themselves, tho' using their utmost means to repress the said Motions.

By the impulse of Nature it is that Animals are carried to *Venery*, or as it were forc'd by a certain violent inclination to a conjunction with their like, for the propagation of their Species.

This Inclination of Animals hence arises, namely, because at their fit Age the Seed increast in the Vessels appropriate to Generation, and the reception of the said Seed upon some access of heat from the afflux of the *Spirits*, provokes *Concupiscence*, which in Males from the sight of the Female, and on the contrary in Females from the presence of the Male, by a vehement agitation of the *Animal Spirits*, impels Animals by a certain amorous rage to a Mutual Conjunction, with which they are inflamed, much after the same manner as a rapid Fire shut up in a close Fornace.

There sometimes happens to one a Laughter against his Will, even in excess of pain, or else at the point of death; and such a kind of Laughter is called *Canine* or *Sardonick*.

Old Women impute this sort of Laughter in Infants to a sign of Joy, when indeed it is nothing but a Convulsion of the *Muscles* of the Face, which is very often attended by *Epileptick Fits*. So likewise among *Gladiators* and such sort of *Combatants* it is a most certain sign of instant death; forasmuch as it denotes that the *Animal Spirits* are no longer under the Government of the Mind, but in a tumultuary manner rush sometimes upon these, sometimes upon those *Nerves*, and so that the Link of the Mind with the Body is almost broken.

When any one is struck with horror, his Hair (as it were) stands on end. Because when the Blood, by reason of the said astonishment, withdraws to the *Bowels*, the external parts of the Body, especially the *Skin*, are contracted; nor can it be but that by the contraction of the *Skin*, the pores also are compress'd, and thereupon the Hairs start up. Because the pores of the Body are like *Repositories* in which the Hairs are disposed, which according to their different situation, obtains a various position. The same effect is stirred up in other Animals by the motion of some affection or other; as for example, Anger in a Dog, fear in a Hen, whose Feathers rise up again, if the Enemy be at hand ready to seize her.

In some it is observed, that after Meat, from the fulness of their Stomach they fetch deep sighs, and draw their Breath from the very bottom of their Breast, like persons affected with some languishing distemper.

This I judge proceeds from a motion which Nature makes use of, the sooner to transmit the juice of the Meats through the Heart, to the end the Stomach may the more speedily be relieved by them. For sighs by agitating the Lungs, cause the Blood which is contained therein to flow the more speedily through the *Arteria Venosa* into the left Ventricle of the Heart, and thus the new Blood created of the Meats juice flowing from the Stomach, the *Lactéal Veins* and Heart, as far as the Lungs may the more easily be admitted into it.

In some Persons affected with Sadness, the Appetite being quite taken away, all sorts of Meat become loathsome to them. On the other side, others languishing with sorrow, covet Meat with a more sharp and greedy propensity,

II.
Whence
arises the
Impulse of
Animals to
Venery.

III.
Whence
Sardonick
Laughter
proceeds.

IV.
How it
comes to
pass the
Mens Hairs
stand on
end who
are struck
with hor-
ror.

V.
Some after
a full Meal
fetch deep
Sighs.

VI.
Why of sad
Persons,
some covet
Meat, others
refuse it.

The

The difference arises from the different *original* of these two sorts of *sadness*. The *original* of the first, which affects some from their very Birth, is from hence, namely, because they took not in *nourishment* enough, but were kept short of such an allowance of *Meat* as might satisfy the appetite. Of the Second sort, that the *nourishment* they first took was grievous and hurtful to them, and thereupon the motion of the *Spirits* in them which takes away the desire of *Meat*, remain'd join'd with *sadness*. For such is the *Conjunction* of *Body* and *Soul*, that these very *Cogitations* which have accompanied any motions of the *Body* from the very first entrance into life, continue to accompany them.

VII.
Sudden
Joy causes
Swooning
and Faint-
ing away,
and some-
times even
to death.

Some fall into *swooning fits* upon their being seized with excess of joy, as for example, that *Woman* mentioned by VALERIUS MAXIMUS, who at the sight of her *Son*, whom she thought to have been long since slain in *Battel*, fell immediately dead. I have heard of a certain *Merchants Wife* in England, whose *Husband*, taking a voyage into the *East-Indies*, was by some Friends reported to be dead, that when after three years she heard that he was returned, and even just at the very doors to enter, she running hastily to meet and embrace him, fell down dead on the Threshold at her *Husbands Feet*.

The cause of this I judge to be, for that the said excessive, sudden and unwonted joy, by opening the *orifices* of the *Heart*, forces the *Blood* of the *Veins* to enter with such violence, and in such abundance into the *Heart*, that it could not be there dilated and rarefied soon enough to remove those *valvules* which close the *Orifices* of the said *Veins*, whereby it came to pass that the *Fire* in the *Heart* was suffocated, and the *Life* which consists in the motion thereof perisht.

VIII.
Why upon
the Yawning
of one
Person,
others also
Yawn.

It happens very often, that upon the yawning of one Person, the rest of the Company fall a yawning or gaping also.

Oscitation or *Yawning* is nothing but the deduction or parting asunder of the lower *Jaw* from the upper, which deduction proceeds from some sharp particles there sticking and gently vellicating the *Fibrils* of the *Nerves*, whereby the *Spirits* have a more copious influx towards those *Muscles* of the *Mouth*, and so produce the said motion. But that upon one Persons *Yawning*, others should do the like, it proceeds from no other cause but this, namely, that the said deduction of the *Jaws* so disposes the *Animal Spirits*, that they rush towards that part, and so excite an *Oscitation* or *Yawning* together, much after the same manner as two *Musical Chords* or *Strings*, which being scrow'd up and tun'd to the same note, so sympathise together, that when one being struck sends forth a *sound*, the other at the same time, though not struck, sends forth the same.

IX.
How it
comes to
pass that
Persons ex-
cessively
grievous,
fall into a
Swoon.

A *Lipothymie* or *Swooning away* through failure of the *Spirits*, oftentimes proceeds from great grief.

The *original* of a *Lipothymie* is when the *Animal Spirits*, be it for what cause it will, are carried impetuously through the *Nerves* to the *Heart*, and contract its *Ventricles* at that very time when they ought to be dilated by the *Blood* entering in; whence it comes to pass, that the fermentation of

the *Blood* is hindered, and consequently that the *Blood* within the very *Ventricles* of the *Heart* cannot be sufficiently rarefied, nor strongly enough thrust out into the great *Arterie* adjoining; whence it is that this *Lipothymie* proceeds from great grief, in regard the whole contexture of the *Nerves* is thereby shattered, and consequently the *Arteries* themselves that receive the *Ramules* or little *Bran-ches* of the *Nerves* are also shattered, whereupon the *Blood* contained in the *Arteria Magna* or Great *Artery* is forc'd upward towards the left *Ventricle* of the *Heart*, and thereby hinders the *Blood* contained therein from being able to pass. This is the true cause of the *Lipothymie* or *Swooning Distemper*.

Those that are *sad* and *dejected* of *Mind*, are very prone and apt to shed *Tears*, especially if the heaviness of *Heart* be not very excessive, and any sense of *Love* attends it.

The Reason is, because tho' from all parts of the *Body*, *Vapours* exhale, yet there is no part which sends forth more than the two *Eyes*, both in respect of the magnitude of the *Optick Nerves*, as also the multitude of the little *Veins* through which the said *Vapours* tend thither. But, whereas *sadness* by cooling the *Blood*, contracts the passages of the *Eyes*, and keeps back the agitation of *Vapours*: *Sadness* alone is not sufficient to draw forth *tears*, unless there be also an accession of *Love*, which is an occasion of discharging the *Blood* towards the *Heart*, and of increasing the quantity of *Vapours*: Whence it is observable that the *Sad* do not shed *tears* continually, but only by *Intervals*, whilst the *Object* they love recurs to their *Mind*, and is represented anew to their *Imagination*. The *Ancients* have allowed this expression of Grief even to *Brute Animals*. *Horses*, saith PLINY, bewail the loss of their *Masters*, and weep for want of them; and concerning the *Horse* of slain *Pallas*, *Virgil* thus writes.

The War-Horse Aethon, spurning now aside
His Warlike Trappings, Ornaments of Pride,
Weeps as he goes; and for resentment sour,
Down from his Cheeks the great drops trickling
(*peur.*)

A loud *Outcry* is oftentimes adjoined to *Weeping*, especially in *Children* and *Women*, who, tho' they are both prone to *Laughter*, yet send forth louder and shriller *Crys* in *Weeping* than in *Laughter*.

These *Scrieks* are produc'd when the *Lungs* are in a moment puff'd up by the abundance of *Blood* entering into them, which expels from thence the *Air* that filled them, which *Air* being transmitted through the *Throat*, produces those *howlings* and *crys* which accompany *weeping*. But because the *Nerves* that are inservient to the dilating or contracting the *Organs* of the voice to render the said *Voice* more acute or gracile, are joined with those, which in time of joy open the *Orifices* of the *Heart*, and in *sadness* contract them: Hence it comes to pass, that these *Organs* are at that time dilated or contracted. Hereupon in *weeping* the *Brows* are contracted and depressed, the contrary whereof we find in *Laughter*.

X.
How it
comes to
pass that
Persons af-
fected with
Sadness or
Grief, are
apt to shed
Tears.

XI.
How it
comes to
pass that
those who
weep, not
only shed
Tears, but
also send
forth loud
Scrieks and
Out-crys.

XII.
Why Lovers
so often sigh.

Lovers commonly fetch deep sighs, and as an argument of their solitude and grief, pant and draw their *Breath* thick from the bottom of their *Breast*.

The Reason is, because in *Love* the *Imagination* of *Hope* or *Joy* opens the orifice of the *Arteria Venosa*, which *Sadness* had before contracted. Wherefore when that small quantity of *Blood* which remained in the *Lungs*, is in a moment conveyed through this *Vena Arteriosa*, into the left *Cavity* of the *Heart*, and is impelled thither, by a desire of obtaining that *Joy*, where at the same time all the *Muscles* of the *Midriff* and *Breast* are agitated; it comes thence to pass, that the *Air* is very quickly impelled through the *Mouth* into the *Lungs* to possess that place which is forsaken by the said *Blood*.

XIII.
How it comes
that the
Sad have
not always
in their
Countenance
the
same Colour

The *Sad* carry not always the same Countenance; for sometimes they look *Pale*, other times are of a *Ruddy Colour*.

Sadness inclines to *Paleness*, when by contracting the *Orifices* of the *Heart* it causes the *Blood* to flow more slowly into the *Veins*, and as being made colder and thicker, to possess less place; whereby it comes to pass, that betaking it self into the broader *Veins*, and those nearest the *Heart* only, it forsakes the remoter, whereof the most conspicuous are those in the *Face*: And by this means the *Lover* is rendred the more *Pallid* and *Macilent*. But when the *Sad* look *Red*, and discover a certain *Ardour* in their *Countenance*: It is not so much to be imputed to *Sadness* as to other *Affections* which are joined to this *Passion*, namely, *Love* or *Desire*, or possibly sometimes *Hatred* it self. Forasmuch as these *Passions* moving and heating the *Blood* which proceeds from the *Liver*, *Entrails*, and other interior *Parts*, and impelling it first to the *Heart*, thence through the *Aorta* to the *Veins* of the *Face*, cause the said *Face* to look *Red* and *High Colour'd*.

CHAP. X.

Of some Persons Natural Inclinations and Aversions.

I.
How it comes to pass, that of two Gamesters we favour one more than the other.

IF by chance we fall into the Company of two *Gamesters* equally unknown to us; We by I know not what *Instinct* of *Nature* are apt to favour one more than another: And so likewise if we see two *Persons* playing at *Tennis*, we wish success to some one of them rather than the other.

The *Peripateticks* impute the Cause of these *Natural Inclinations* and *Aversions* to that which they call *Sympathy* and *Antipathy*; which obscure and insignificant Terms, serve only for one main end, namely, for a Cloak to cover our *Ignorance* under the umbrage of a few large striding and big swelling words. We therefore assert, that this *Inclination* whereby we favour one Party rather than another; if this propension continues no longer than the *Game* lasts, proceeds from hence, viz. that our *Will* which flies all *Indifference*, and affects to be concerned about some or other *Object*, takes an occasion to join it self to some *Party*, altho' the *Soul* be induc'd by no apparent Reason, more to favour one than the other, or to wish success on

any particular side, but only suffers it self to be drawn over towards that *Dice-brower*, or *Tennis-player*, who at that time most sweetly soothes his *Brain* according to the tenour of its disposition. But if this *Affection* survives the *Game*, and after the *Match* ended remains still fixed in his *Heart*, it proceeds from the *Vestigia* or tracts of the *Inclinations*, the original whereof I have shewn in my *Institution of Philosophy*, Part 9. Cap. 14.

But if we remember not the agreement or similitude which the *Objects* we love or reject at present, have with those which we formerly had a love or aversion for, it is because the first *Passions* out of which the Second proceeded, were mightily confused, as being the very first *Passions* of our *Imagination*, or at least such as we no way ever considered with attention, and were of the number of those whose *Object* we loved or hated, without any trial or weighing of Reasons, or Animadversion of what might be worthy in them of *Love* or *Hatred*. Wherefore the Second also are partakers of the same obscurity and confusion as the First; and we are very often forc'd to say with the Poet,

I love thee not *Labidius*, say no more;
I love thee not, but cannot tell wherefore.

There is scarce a *Country* or *Province*, in which there are not many persons who have not an extraordinary aversion to *Cheese*, of whom some there are, who not only have a great abhorrence from the eating of it, but also cannot without much trouble and offence behold the sight of it.

The Cause of this *Aversion*, Sir KENELM DIGBY judges to be, for that *Children* many times are suckled by *Nurses* with *Child*, and in whose Breasts consequently by reason of a new conception the *Milk* is curdled, which may possibly offend the weak *Stomach* of the *Infant*. For without doubt a very great alteration must needs be made in the *Milk*, by reason of the *Nurses* pregnancy; and the *Milk* thus corrupted being suck'd in by the *Infant*, degenerates in his *Stomach* into a vitious curdle of *Cheese* grievously distasteful to the *Childs* weak *Stomach*; whereupon this aversion sticks upon it as a lasting brand during the *Parties* whole life. So a certain *Lawyer* in *London*, going to sup up a *Rear Egg*, and chancing unawares to swallow the *Embryo* of a *Chicken*, entertained from that time forth such an aversion for *Eggs*, that upon no occasion, nor by any perswasion of *Physicians*, could ever be brought to eat any more *Eggs*. This cause for nauseating of *Cheese* in many, I can well enough allow, but that all who suck coagulated *Milk* should for this cause only have this aversion I can never admit, when as we daily see a vast number of *Women*, especially of the common and meaner sort so fruitful, that they bring *Children* every year, whom they suckle at the time of their being with *Child*, and never wean them till they are near their time. So that if all the *Children* who have suck'd the *Milk* of *Big-bellied Women*, should be initiated in this aversion for *Cheese*, and increase it with their *Age*, how vast would their number be? And in how short a time would *Cheese* grow cheap?

Where-

II.
Why we should so favour, when nothing occurs that should impel us to it.

III.
Whence it is that many have an aversion to Cheese.

IV.
Sir Kenelm Digby's Opinion.

V.
A more probable Opinion.

Wherefore my Opinion is, that there may be another cause of this *Aversion*, either their *Mothers Longing*, or greedy desire of certain *Meats*, which when they cannot be obtained, the *Infants* soon after born, abhor and loath them, or else because *Cheese*, especially *Old Cheese* abounding with *Volatile Salt*, and many other putrid particles, might possibly raise such a confusion of particles in the *Blood*, that great inconveniences might thereupon arise, especially to *Infants*. What wonder therefore, that this effect should be continued in *Adult* or full grown *Persons*? So far as that the very smell of *Cheese* cannot be indured by many. Nay, though it be fraudulently mixt with other *Meats*, and administered to the Party not knowing the cheat; nevertheless it will either cause a violent Vomiting, or if that happen not, many inconveniences and disturbances will thence arise.

VI.
How it comes to pass that some are so impatiently affected with the stink of a Candle carelessly put out.

A certain *Nobleman* of *England*, of my particular acquaintance, had so great an abhorrence of the *fuming snuff* of a *Tallow Candle* put out, that if by chance it hapned at any time through the negligence of the *Servants* to be carelessly blown out, and not covered with an *Extinguisher*, he was so disturbed with the smell thereof, that he became all of a sweat, and was discerned to tremble every Joint of him.

This could not happen to him upon any other account, than because this *Organ of Smelling* was so attuned according to the insensible particles, that the more subtle particles of the said *Fumous Vapour* begat in his Nose an ungrateful motion, that is to say, a most abominable smell, much in the same manner as *Smoke* falling into the *Eyes* provokes to *Tears*, and pricks and wellicates the *Tongue* it self.

VII.
How it happens that some mightily abhor the sight of a Cat, or such like Animal.

Some *Persons* can by no means indure the sight of certain *Animals*; nay, are highly disturbed if they happen to be in the same place where they are, tho' not seen; particularly some have such an aversion for the presence of a *Cat*, that at the sight thereof they fall into a *Swoon*.

This may very well be, for that when they were yet *Infants*, and in their tender years, they were hurt by a *Dog*, *Cat*, or some other noxious and hostile *Animal*, tho' perhaps retaining no memory of the Wound inflicted, and consequently they may experiment in themselves, at the first sight of the *Animal*, the same commotions as well of *Body* as of *Mind*, with which heretofore they were affected, either upon the foresaid occasion, or else because their *Mothers* when they bore them in the *Womb*, were affrighted at the sight of the said *Animals*; or lastly, because their temperament of *Blood* and *Spirits* is such, that the Evaporation continually exhaling from the *Body* of the *Cat*, and transmitted by respiration, coagulates, fixes, and after an unwonted manner exaggerates the *Blood* and *Spirits* with which it is intermixt. Whence no wonder they undergo so great a perturbation, and sometimes fall into a *Swoon*. If other *Men* have the fortune not to be taken with these *Passions*, it is because they are of a different temperament, and are not affected with the

exhalation of the *Cat*, evaporated by the circumambient *Air*.

Upon the same ground we must suppose that *OLIVER CARAFFA* abhorred the smell of *Roses*, when every year in *Rose* time he was forced to withdraw from *Rome*, and live recluse among the *Gardens* in the *Quirinal*, *Guards* being set at his *Gates* to hinder any of his *Friends* and *Visitants* from carrying in a *Rose* with them. In like manner a certain *English Lady*, mentioned by Sir *KENELM DIGBY* had such an abhorrence to the smell of *Roses*, that when one of her acquaintance put a *Rose* upon her *Knee* when she was asleep, to try whether she had so great an *Antipathy* to that *Flower* as was reported; there grew *Pimples* immediately upon the *Place*.

VIII.
How it comes to pass that some abhor the smell of Roses.

The *Original Cause* hereof might be from a strong scent in the *Mothers Womb*, or in the *Cradle*, or haply some other place, tho' totally forgotten; by which the temperament of the *Brain* hath been hurt, and the *Mind* affected with trouble and disturbance. And these or the like affections as well of the *Body* as of *Mind*, may easily be allowed, tho' a long time after, to survive, in the Parties, the *Original Cause*. To which we may add, that in regard the *Fibres* of the *Sensory* or *Organ of Smelling* are according to the diversity of *Men*, diversly configured: It thence comes to pass, that things of any *Odour* or *Smell*, affect not all persons alike, since that some *Objects*, as being indured with rough and pungent Effluvia, are by some accounted sordid and odious, which very things to others that have notable strong and tough *Fibres* in that *Sensory*, are sweet and grateful. I know a great *Lady* that takes much delight in the smell of *Stinking Flesh*, and admires the *fuming Snuff* of a *Candle* new put out.

IX.
The Reason of this Aversion.

A *Gentlewoman* in *Oxford* hated a *Wasp* to that degree, that in the hot *Summer Months*, when *Wasps* fly frequently about in *Houses*, she used to keep her self close shut up in a *Chamber*, not daring to stir out into a *Dining Room*, or any such like large or open place, till such time as she had news from those that she durst give credit to, that this sort of *Insect* was destroyed, or at least was no longer seen.

X.
Of one who abhorred a Wasp.

This *Aversion* probably hapned to her from some mischief or incommodity she had received from this kind of *Animal*: As they who having drunk for a *Medicin* some kind of bitter *Potion*, take such a distast from thence forward at it, that they will not indure to taste, nor even to behold, nay not so much as to look upon any thing that is like it. Likewise there goes a Report of a *French Nobleman*, who had such an *Antipathy* to *Garlick*, that he could not taste the least Crumb of it without Vomiting; and after he had with good satisfaction made an end of a *Mess of Broth*, into which, for his sake, no *Garlick* was put, yet when one of the Company, to play the *Wag* with him, told him there was a little *Garlick* shred in it to give it a relish, he vomited up both the *Broth*, and all that he had eaten besides.

All

XL
How it
comes to
pass that
Men have
various
Natural
Inclinati-
ons.

All Persons by Nature are incited to certain *Passions*, some to one, and some to another; some are prone to *Anger*, and fly into *Rage* upon every slight occasion; others are of a disposition that inclines them to *Sadness*; others are addicted to *Joy*, *Fear* and the like.

The diversity of these *Passions* proceeds from the contexture of the *Fibres*, and the different *habitude* of the *Humours*. Forasmuch as *Choler* incites to *Anger*, *Melancholy* to *Sadness*; *Blood* bounding to *Joy*. In regard *Choler* vellicates

the *Fibres*, *Melancholy* compresses them; *Blood* dilates them, *Pblegm* obstructs them. Which effects we find certain both *sleeping* and *waking*. Those in whom *Choler* abounds, think of nothing but *Firebrands*, *Burnings*, *Fights* and *Brawls*. The *Sanguine* mind *Dancing*, *Musick*, *Laughter*, *Sport*, and all that tend to *Lasciviousness*. The *Pblegmatick* *Fancy* watry *Places*, and *overflowings* of *Rivers*; and so of the rest according as they abound in *Humours*, or have their *Spirits* disturbed.

ADVERTISEMENT.

THERE are some things taken notice of in this HISTORY of NATURE, which probably may seem impossible to some; But the Author Mr. LE GRAND is ready to justify the same, as well from Authentick Authors, as from Natural Causes, to such as shall be dissatisfied therein. And the same being Printed in all the Latin Impressions, and so well received, there is little room left for any real Dispute.

A

THE THIRD PART.

A

DISSERTATION

Of the want of

SENSE

AND

KNOWLEDGE

IN

BRUTES.

i.
What it is
that moves
some Philo-
sophers to
believe
that Beasts
have know-
ledge.

SO far hath the Opinion concerning the Knowledge of BRUTE ANIMALS prevailed amongst Men, and so infixt hath it been in their Minds, that they who dare think otherwise, and refuse to patronise a Cause which to them appears so clear, can hardly escape the censure of Folly and Temerity. In this Opinion almost all Philosophers agree, and whether induc'd by the industry and vivacity of Sense, which they observe some Beasts to be induc'd with, or fancying that they see some Idea's of Reason in them, they make no scruple to attribute Knowledge and Ratiocination to them, and pronounce them capable of those perceptions and apprehensions, which in reality distinguish human kind from all other Creatures, not being able to imagine how without the help of Reason, BRUTE ANIMALS should bring such wonderful things to pass, and discover in their actions such a world of Ingenuity; as for example, how BEES, if void of Knowledge, should build so Geometrically their sexangular Cells, and fill them so exactly at their certain times with Honey. What, say they, can these Creatures Act so regularly, Consult so deliberately, make Choice so prudently of their Kings and Captains, and send out so seasonably their Scouts to watch and bring in a supply of Provisions, and not at the same time give an evident proof of a Rational Knowledge; since in all these Performances they cannot be supposed to be carried on by a blind and unaccountable impulse of Nature. For what impulse of Nature or Corporeal Energy can be capable to inspire a meer living and moving Machine with Sense, and apprehension enough to constitute a King, obey his Commands, give him their presence, attendance and assistance upon all occasions? How comes that band of Soldiers appointed for his Guard? How

comes it that one more than another performs this *Satellitory Office*? Is it likely that by meer chance Serjeants and Officers should be chosen for his preservation, and sometimes to bear him up, when weary, upon their Shoulders? If destitute of Reason, they are totally ignorant of what they do in all these performances: Yet let us further inquire how the Living of them should carry out their Dead, and after the manner of Mourners accompany their Exequies? Certainly it must needs be very absurd, not to attribute to Reason so many plain signs and evidences of Reason, and after the discovery of such effects, not to find out the latent Cause.

No less discoveries the SPIDERS make of their Industry and Ingenuity in the curious weaving of their Webs, and hanging them loose in Doors and open Passages, wherein is likewise observable the manner of their lying in wait for Flies: For why should they place their selves to lie upon the watch rather in the center than in the extremities of the Web, but that they are sensible of the equality of the Lines drawn from the Center; and like skilful Fowlers understand that the Net is more easily drawn in that place. Moreover, if we well observe the ingenuity of certain other Animals, we shall find in them no weaker evidences of Ratiocination, than in those already mentioned. What providential care and forecast is to be seen in the GEESE of Cilicia, who conscious to themselves of their garrulous Nature when they pass the Mountain Taurus, for fear of the Eagles, take each a Pebble Stone in their Bills, by which means they are forc'd to silence, and do not give notice to the Enemy of their coming. Moreover, who can but admire the Industry and Art of the ANTS, who build their Cities with so much design and regularity, that the

ii.
The Indu-
stry of Spi-
ders, im-
plies a sup-
posal of Rea-
son, latent
in them.

several Offices in them, may easily be discerned, some for holding their *Assemblies*, some for laying up their *Provisions* against the following year, and some for the *burying their Dead*. *Aldrovandus* was an Eye-witness of a City of a *Quadrangular form*, four foot broad, in which the *Ants* were seen to run to and fro through their several *Paths* in great diligence, as it were about their earnest affairs. It was exactly drawn in straight *Lines* and *Angles*, and the length thereof was just divided in the midst by a straight Path of a *Fingers depth* and breadth, through which ran three other ways directly, intersecting it at equal distance one from the other, and of the same depth and breadth. In the extreme *Angles* of these ways, as it were at so many *Streets ends*, their *Eggs* were laid up together in heaps. In another part of the City were *Granaries* filled up with *Grains of Wheat*, so full that the *Paths* were strewed with the overplus, but else all the ways were kept very clean: Lastly, one only Gate there was at the end of the *Cities* length which looked toward the *West*.

These and the like things reported of these *Animals*, do more than enough evince the *Natural Knowledge* they are endued with, and are sufficient to force a *Confession* from the most *Refractory*.

III. By these Reasons the *Ancients* were induced to believe the *Souls of Brutes* were *incorporeal*, and no way differing from those by which the *Bodies of Men* are animated; or if there were any difference between them, that it did not consist in the *Essence*, but was caused by certain accidents; or by the several degrees of perfection. Hence that passage in *GALEN* about the beginning of his *Exhortations*: *Whether those Animals, which are commonly called Brutes, be totally void of Reason, is not yet sufficiently made out to us; for tho' perhaps they have not that Reason common with us, which is called Enuntiation or Vocal Expression, yet they have that Reason common with us which belongs to the Soul, that is, a Reason capable of Affections, tho' some more, some less.*

IV. Very much inclinable to this Opinion were *Plato* and *Pythagoras*, by the Testimony of *Lactantius*; and *Ibales*, by that of *Plutarch*; and almost all those who gloried in the Learning and Authority of those great *Philosophers*: Forasmuch as supposing that there is one *Universal Soul*, by which *Plants* have their *Vegetation*, *Brutes* their *Nourishment*, and *Men* their *Form* and *Understanding*: They thence infer, that the *Souls* as well of *Brutes* as *Men*, are parts of this *General Soul*, and that they all arise and spring from the manifold division thereof.

Upon the confidence of this Opinion, *Thales* took the boldness to affirm, that all things are full of *Divinity*; consequently that there is no *Body* existent, which hath not its particular *Demon*; and so compriseth in it self something of *Divine*. Blinded also by this conceit, the *Disciples* of *PLATO* asserted that the *Souls* both of *Men*, and all other *Creatures* are equally mortal and void of all corruption: For since they are active and move themselves by their own proper Force, they cannot by any external Agent be urged to Rest, for that must of necessity perpetually exist which depends not upon another, and bor-

rows not the permanency of its duration from any.

But this Opinion hath long since grown out of date, and is reckned by the *Fathers* among *Plato's* *Childish Fictions*, so that there is no necessity of encountering them with Arguments: Let it suffice to take notice what enormous absurdities must needs arise from the admitting of this Opinion, and what confusion in Nature would follow: For if the *Souls of Brutes* be eternal and invested with immortality, what distinction will there be between *Men* and other *Animals*? Doth the same felicity attend them as us? However, not to be over solicitous about the beatitude of *Beasts*, let us at least examine where those *Souls* are disposed, which have been existent from the beginning of the World; what *Places* are allotted for them? Whether they have any peculiar *Elysian Fields* assigned them to wander and exspatiate in? What is become of all the *Gnats* and *Flies* with which the *Egyptians* were heretofore disturbed? What was their business after *Death*? And to what end were they kept? Or what advantage accrewed from their *Death*; when it must be confessed by all *Men*, that *God* governs all things by his wonderful Wisdom, and directs all *Creatures* to a certain end. All these things considered, it is most consentaneous to Reason, that the *Souls of Brutes* return to the *Earth* from whence they had their first beginning, and cease to live, when they cease to be among us.

But not to wander too far in the very entrance of this Discourse, let us come to the purpose, and examine whether *Animals* are indued with a *Real Knowledge*, or can judge or reason of things that are without them; which that we may the more easily compare, it will be worth our while in the First Part of this Discourse to inquire, First, what the *Soul* is, and what sort of *Soul* is proper to *Brute Animals*. Next what *Knowledge* is, and wherein the formal Reason thereof consists. Lastly whether *Beasts* perceive, and what Principle guides them in all their Actions.

To begin with that which in the first place was proposed, it will be of great consequence to know what the *Soul* is, and what is imported by that *Vulgar Name*; for when *Men* first imposed Names upon things, before they well understood their *Natures*, and enquir'd into the Properties of each distinct one from the other, it followed of consequence, that the name of *Soul* was indifferently attributed to all *Living Creatures*; and as well *Plants* and *Trees*, as *Men*, and all other *Living Creatures* were said to be indued with *Souls*. But in this affair no *Man* erred more than *Aristotle*; forasmuch as going to define the *Soul* in general Terms, this cunning *Philosopher* took great care that he might not be carpt at by *Posterity*, and thereupon brought forth such a definition of a *Soul* as might be applied almost to all things, and so serve as a common *Plaster* for the healing of all Sores. For in his Second Book *De Anima*, going about to explain the *Essence* of the *Soul*, he defines it thus. *A Perfection or Act of a Natural Organick Body, potentially endued with Life*. But how wild a definition this is, may be hence collected, namely, for that *Divines*, *Physicians*, and others, do all make use of it alike, and in so doing, appropriate it to things of a quite different Nature.

V. This Opinion of theirs admitted, there will be no difference between Brutes and Men.

VI. The Order of things to be said in the First Part of this Dissertation

VII. Aristotle's definition of a Soul, warm and frigid.

Nature. For *Theologists* and *Interpreters* of *Holy Writ* assert, that the *Soul* of *Brutes* is the *Blood* or *Spirit* exhaling from the *Blood*. To make this good, *Aristotle* is presently at hand, and suggests that the *Blood* is the *Act* of a *Natural Organick Body*, having *Life* potentially. The *Physicians* are pleased to make the *Soul* a temperament of the *Body*, and a harmony of the *Humours* which abound therein. This according to *Aristotle* must be that *Act* of an *Organick Body* which hath *Life* potentially in it. Antient *Philosophers* maintain that the *Air* is the *Soul*, taken in at the *Mouth*, cooled in the *Lungs*, and diffused into the *Body*; this comes up in conclusion with *Aristotle's* definition of a *Soul*, since he also defines *Air* to be the perfection of a *Natural Body*, potentially indued with *Life*. Others suppose the *Soul* to consist in *heat*, or at least that it is a *subtile Spirit*, which gives *sense* and *motion* to the *Body*; this *Aristotle* doth not wholly gainsay, yet withall obstinately maintains that this sort of *heat* or *Spirit* is nothing else but the *Act* of a *Natural Organick Body*, having *Life* potentially in it, so that whatsoever shall be alledged, or fancied concerning the *Soul*, tho' never so obscure, must be comprehended under this definition, and will challenge to it self both the *Genus* and *Difference*.

VIII.
May ob-
scure, and
explaining
nothing di-
stinctly.

But tho' this definition did not dilate it self so far, and were only confined to certain things, yet were it not fit to be retained among *Philosophers*; for what is there in it, that ought not to be rejected, it containing in it no absolute attribute which can any way explicate the essence of a *Soul*; nor do things only respectively and generally predicated, and which may be mixt, and as it were link'd with other things, produce any more than a confused *Knowledge*. Besides, what is there distinct, that can be made intelligible to us by the word *Act*, no more indeed than if any one should define *Light* to be the *Act* of a *Lucid Body*, or *Heat* the *Act* of a *Calid Body*; which definitions are so far from rendring us any whit more wise than before, that they serve only to involve us in an inextricable *Labyrinth*, and by a strange ambages of words render that obscure which was far more clear of it self. In so much that *HERMOLAUS BARBARUS*, a Learned Man, and for his great *Wit* and *Parts* very eminent among those of his Profession, when he had ambitiously sought, and at length obtained a Meeting with a *Demon*, is said to have requested of him no greater matter than to be resolv'd in the signification of the word *Actus*, in the foresaid definition of *Aristotle*, that so he might approve himself a worthy *Disciple* of so great a *Philosopher*. These things I have the rather added to make it appear what obscurity the Notion of *Soul* would incur, by being divided into *Vegetative*, *Sensitive* and *Rational*; and how little of *Light* is to be gained from those who make a vast confusion, by comprehending under one and the same distinction, things very different and remote in their own Nature.

IX.
There are
only two
sorts of
things, Ma-
terial and
Spiritual.

To proceed therefore more accurately as to the *Souls* of *Beasts*, and to the *Knowledge* they are indued with; we are to suppose from the Institution of *Philosophy*, that there are in Nature only two sorts of things; one *Intellectual* or *Thinking*, the other *Material* or *Corporeal*. Under the first are

comprehended *MINDS* and *SPIRITS*; under the latter all *BODIES*, which are vulgarly named *Natural*. Nothing can gainsay, but that *Man* is partaker of both *Natures*, and possieth at once both *Cogitation* and *Extension*: Forasmuch as *Man* is not a thing simple and of one kind, but composite, and as it were a *Medium*, including both extremes; so that it is evident that *Brute Animals* are of a different Nature from *Man*, and no way indued with *Mind* or *Spirit*; forasmuch as all things which *Beasts* contain, are to be referred to a *Material Principle*, and have nothing of affinity with *Men*, except what refers to *Body*. We must therefore inquire what *Principle* it is in *Beasts*, by which they are not only Nourish'd, Grow, Breathe, are Moved, &c. but also by which they operate and perform those wonderful things in which they seem not only to come near the *Wit* and *Subtily* of *Men*, but even to exceed them.

GASSENDUS an eminent *Philosopher* amongst the *Moderns*, and so much the more praise-worthy, for that he hath refined and given new light to the *Opinions* of the *Antients*, imagines the *Sensitive Soul* of *Brutes*, (and a more than *Sensitive Soul* no *Man* that I know will allow them) to be a sort of *Flame* or *Species* of most subtile *Fire* which infuses *Life* into the *Animal*, and actuates and performs all its parts; so that the *Animal* lives so long as this little *Flame* continues in vigor, and dies when it is extinguished. For tho' this *Fire* be a *Body*, yet in respect of its subtility, it may be reckoned immaterial, if compared to the rest of the *Corporeal Mass*, and may justly for that Reason obtain the name of *Anima* or *Soul*; and the *Animal* thereupon be rightly said to consist of *Body* and *Soul*. Wherefore if the *Essence* of a *Brute* consists in this, that its parts are subtile and continuous, and are agitated by a quick motion, and there be also a continual succession of some parts into the room of others destroyed; in like manner the *Fire* or *Flame* wherewith *Beasts* are animated, is a *Congeries* and contexture of most subtile *Atoms*, which are stirred up by a quick motion, and by a continual generation of some, and departure of others, always preserve and maintain the same *Essence*: For into what other principle is the *heat* of the *Body* to be referred but to the *Internal Fire*? Whence comes its motion? How shall the *Organs* of the *Senses* receive the impressions of *Objects*, unless they be cherish'd by *heat*? And whence that *heat*, but from the *Soul*, which performs and executes all the functions of the said *Animal*; for tho' it may well enough be said that the *Soul* may rather be kept from *heat*, than *heat* from the *Soul*; yet it is manifest that *heat* depends upon motion, and is not existent in the *Body*, but for that action of an *internal Principle*; so that it must necessarily come to this, that there is a *Material Anima*; as GASSENDUS expresses it, to produce *heat*, give motion to the *Members*, and perform other Acts of the *Animal*.

Not much differing in Opinion is *Honoratus Fabri* in his Second Book de *Homine*, where he concludes, That the *Soul* of *Brutes* is indeed a *Fire*, but pure and free from the mixture of other Elements; to the asserting whereof he is chiefly induc'd, because *Fire* vegetates; and there is most

X.
Gassendus
his Opinion
of the Na-
ture of the
Soul of
Brutes.

XI.
That the
Soul of
Brutes is a
Pure Fire,
according
to Honora-
tus Fabri.

virtue (as experience tells us) where there is most heat, and where that stronger Element prevails. For whereas in other simple Bodies there is no footstep of action to be discerned, and Fire only is powerful by its productive virtue, Reason evinceth, saith Fabri, That if any Element be armed with the force of Sense, it must be allowed rather to Fire, than to any of the rest: Nor that Fire absolutely taken is invested with such a power as to supply the place of a Sensitive Soul, but so far as it is constituted in such a frame of the Organ, such a disposition of Parts, such a Conduct, Communication and Texture of the Fibres.

XII.
Cartesius
his Opinion
that the
Soul of
Brutes is
the Blood.

The most illustrious CARTESIUS, who hath refined Philosophy, and purged it from all its folly and obscurity, and teacheth nothing but what is highly consonant to Reason, supposes the Souls of Brutes to be nothing else but the Blood, and that there is no occasion of a Sensitive Soul for the performance of their operations, and the production of the faculty of moving, and being sensible; for this most Sagacious Person, when he considered the Blood to be a fluid Body, and that the more subtile part thereof is carried by a continual circuit from the Arteries into the Brain, thence into the Nerves and Muscles, doubted not to assert that the Blood heated in the Heart, and attenuated into Spirit, constitutes the Soul of Brutes; and that from its motion alone, their various motions do proceed. This Opinion several places of Holy Writ seem to favour, and vindicate from the pertinacie of certain Detractors, who will needs take upon them, that it paves a way to Atheists, and gives them encouragement to think the same of Men, and consequently to divorce the Rational Soul from the Human Body; when as indeed so great is the distinction between the Souls of Men and other Animals, and so great the difference between the operations of the one and the other, that it can hardly be doubted, even by the most stupid of all Mankind, but that they arise from different Principles.

XIII.
The Life of
Animals
consists in
the continu-
al motion
of the
Blood.

Be it granted then, that the Life of Animals consists in the incessant motion of the Blood, which beginning its course from the right Ventricle of the Heart, passes through the Vena Arteriosa into the Lungs, whence flowing into the left Ventricle of the Heart, it passeth into the Aorta or great Artery, whose Branches are dispers'd through the whole Body, and being joined to the Branches of the Vena Cava, convey the same Blood again into right side of the Heart; so that the Blood heated in the Heart, and converted into Spirits, obtains the name of Vegetative and Sensitive Soul in Animals, and is the immediate and principal Organ of all Actions, as may be apparently discovered in certain Animals; for examples, in Flies, Serpents, Scorpions, Frogs, &c, which through the extremity of cold in the Winter, lie void of sense and motion; and for the time in all appearance, totally deprived of Life, that is, while the Blood ceases to be in agitation, and the generation of Spirits is for the present stopt; which Animals, when the Genial Spring, as Mantuan expresseth it, gives new primordia to things, the motion of the Blood being renewed by heat, are again raised to Life, and resume their long intermitted functions. The same thing may be seen in Men who are hanged or drowned, forasmuch as in a very short time they

expire, by reason that the Blood stagnates for want of respiration, there being no passages open from the right Ventricle of the Heart into the left. The Blood therefore must needs be the principal part of Animals, from whence the native Heat and Spirits flow, and from which to those that are born, Life first begins, and to those that Die, last ends.

Altho' in explaining the functions of Beasts, we make no mention of their Soul; yet at the same time we deny them not Life nor Sentiment, provided always that by Life and Sentiment of Animals, no other thing is to be understood, but the heat of their Blood, and the particular motions of their Organs of Sense which depend thereupon: Nor is this more unreasonable, than to attribute to Beasts a Soul, which should be really distinct from the Body, and which nevertheless cannot subsist without the Body, it being the same thing as to say, that the Soul of a Beast is at one and the same time a Substance and a Mode; a Substance by supposition, and a Mode as having need of a subject for its existence.

Now it being made out, that the Blood overflowing the whole Body, and having by iterated turns a continual orbicular rotation to the Heart, from whence it had its first source, is the real Soul of Brutes, we must pass on to the Second Foundation, as it may be called, namely, what we are to apprehend by that which is commonly called their Cognition or Knowledge, what it is that constitutes their Ingenuity, and into what species chiefly it is to be distributed. The Idea of Cognition is so manifest, that there is scarce any thing which occurs to our Mind, which is more certainly known; and if by chance any persons in the explaining thereof have erred, I conceive the occasion thereof hath been, for that they have by their crabbed Terms, rendred that obscure, which of it self was sufficiently plain; and were minded, as they say, to hold a Torch to the Sun: For in this very thing, I find that all Philosophers have very oftentimes made great mistakes, namely, in endeavouring by Logical Definitions to explicate the most ordinary and simple matters, tho' in their own Nature intelligible; and by certain circumlocutions of words to go about to render those things perspicuous, which voluntarily offer themselves to our understanding; for what Object can present it self more clearly to us than Cognition, when as, if I perceive any thing, I seem to have its Image or Idea before me, and to behold it as it were present, with the Eyes of my Mind. For tho' perchance I be doubtful of all things existing in Nature, and may call in question what I touch with my Hands, see with my Eyes, hear with my Ears, smell with my Nose, or taste with my Tongue; yet all this I cannot choofe but think, and my very dubitation is a certain thinking, which I cannot but be sensible of.

Wherefore by the name of Cognition we are to understand all that which so proceeds from us, that we are immediately conscious to our selves thereof. So that to think or know, is nothing else but to have a perception of those things which are in us. But to make the matter more plain by an Example, How doth any one know that he is indued with a faculty of Understanding, Willing, Affirming or Denying? but because he experi-

XIV.
How is
ought to be
understood
that Beasts
have no
Soul.

XV.
What Cog-
nition is,
and where
in its Na-
ture consist-
eth.

XVI.
Every Cog-
nition in-
cludes a
Conscious-
ness.

in himself this sort of *Faculty*, and is conscious to himself of such a power so long as he exerciseth it. But this is not to be understood of *Reflex Cognition* only, that is to say, by which any one perceives or observes that he hath observed any thing, but also of any primary *Perception* or *Intellection* whatsoever, by which he gives attention to any thing. Whence it follows, that if one have not a *consciousness* to himself of those things which he acts or suffers, he experiments in himself no knowledge of them, and thereupon may be said to be destitute of *Sense* and *Cognition*, properly so called: For how can the *Sense* of *Action* or *Passion* be attributed to him, if he knows not that he *Acts* or *Suffers*? Hence it comes to pass, that if *Men* attentively fix'd upon any thing are so taken up in contemplation, that they perceive not a *Torch* lighted before their *Eyes*, they cannot indeed be said to have any sense or perception of those things. And therefore that they may be said to be *sensible*, to *perceive*, *judge*, *affirm*, *deny*, &c. they must needs be knowing of those things which they are sensible of, *perceive*, *judge*, &c.

XVII.
Cognition
is divided
into four
Kinds.

All *Cogitations* which include *Consciousness*, are most especially two fold, *Actions* and *Passions*. All species of *Perceptions* or *Cognitions*, which are found in us, or which proceed from the power we have of perceiving or knowing, are called *Passions*; and all such *Operations* are divided into four kinds, the first is *Intellect*, by which the *Mind* without the help of any *Corporeal Species* perceives all manner of *Objects*, as well immaterial as material: The second is *Sense*, as well that which is external, as internal: The third is *Imagination*, containing under it common *Sense*; forasmuch as they are both actuated by the same *Organ*, and are employed about the same *Objects*: The fourth is *Memory* or *Reminiscence*, being that faculty by which we deprehend that we had formerly the same *Cogitation*. Those *Cogitations* which are called *Actions*, are all our *Wills*, because we find them to proceed directly from our *Soul*, of which alone they seem to depend; and to these are to be referred all our *Judgments*, *Inclinations*, *Appetites*, and all the *Motions* of our *Will*, which always accompany the power of our *Willing* and determining.

XVIII.
How Corporeal
Matter differs
from Immaterial
and Incorporeal.

These things being thus explained, as far as the brevity of our Subject would permit, and premised as the foundation of our *Discourse*; We come now to examin whether the *Cognition* above-mentioned and defined be to be attributed to *Brute Animals*, or to speak in more express Terms, whether *Beasts* perceive, are sensible, imagine, remember, &c. and whether they imitate *Men* in these *Operations*, so far as to carry in them any semblance of *Reason*; which to make out the more clearly, we are to call to mind, that the Nature of *Corporeal Matter* consists precisely in this, that it contains *Longitude*, *Latitude* and *Profundity*, or that it is a *Matter Extensive*; for to consist of these three dimensions, is no other thing than to be extended, and to be extended is no other than to be capable of those three *proprieties*: To *Body* or *Matter* the *Spiritual Part* is *diametrically* opposite, whose Nature consists in *Cogitation*, and which admits of no dimension, either *Longitude*, *Latitude* or *Profundity*; for all that is known to be in a *Spiritual Essence* is, that it is a *thinking thing*, that is, *Per-*

ceiving, *Affirming*, *Denying*, *Willing*, *Nilling*, &c. All which are understood without any *Idea* of *Extension*, and have no affinity with *Divisibility*, *Figure*, *Situation*, or any other *Affections* of the *Body*; and thence we must conclude, that *Cogitation* is an *Attribute* of a *Substance* containing no *Extension*; and on the contrary that *Extension* is an *Attribute* of a *Substance* admitting of no *Cogitation*: For those two *Idea's* are utterly different, and represent to our *Mind* nothing that is any way alike. What conduces more to the evidence of one thing being distinguish'd from another, than that one may be conceived without the other? For if we rightly infer that those *Bodies* which are not *square*, may be of *Spherical Figure*, and that those which are least capable of *motion*, are *square*, since *Imagination* can soon distinguish *quadrature* from *rotundity*, and ascertain that it is the nature of a *square Body*, to be least apt for *motion*; may not the same Reason serve to conclude, that there may be certain *Substances* void of *Extension*, because the *Idea* which we form to our selves of *Extension*, differs from the notion of *Cogitation*? Forasmuch as to establish a difference between two things, it sufficeth that one may be distinctly perceived without the other.

From this Principle then being granted, it is most clearly to be inferred, that *Brute Animals* are not only incapable of *Cogitation*, but are also void of every simple *Perception*: For whatsoever sort of *Soul* may be fancied to be in them, whether *Blood* circumsufed through the whole *Body*, as the Noble *CARTESIUS* maintains, or a pure *Fire* or *Flame*, as *FABRI* and *GASENDUS* will have it; giving *Life* and *Spirit* to all the parts thereof; we must of necessity admit that this sort of *Soul* is *Corporeal*, and contains not any thing alien from the nature of *matter*; forasmuch as tho' *Blood* rarified in the *Heart*, should evaporate into *Animal Spirits*, which like a most subtle *Wind*, ascend up into the *Brain*, and are conveyed through the *Nerves* into the *Muscles*; and tho' this *Flammula* be composed of the most subtle parts, and emerging as it were out of the grosser Mass, may seem to emulate the agility, as I may so say, of *Spiritual Things*, yet nevertheless it doth not for all this cease to be material; nor do those accidental qualities advance it above the condition of a *Body*: So that if *Cogitation* be denied to *Matter*, and a thing extended be not in a capacity to be conscious of that which happens to it, that very thing will be against materiality, tho' never so subtle, and diffusing it self through any whole *Body*: For the tenuity of *Parts* takes not away the Being of the *Matter*; and whatsoever is capable of being extended, that Capacity is sufficient to give it the name of *Matter*, and to invest it with, and make it partaker of its imbecility: Who can say that that subtle *Matter* which enters the *Pores* of *Gold*, *Adamant*, *Steel*, or whatsoever other solid *Body*, is of a nature different from *Body*? *Accidents* change not the *Essence* of things, and the subject must of necessity remain always the same as to *Essential Proprieties*, let it be changed never so much, or undergo never so many new *Denominations*.

What is it that can conduce to the making up of a *Body*? All that we conceive of it, is that it may be touch'd, remov'd, and have its *Figure* alter'd,

XIX.
Whatsoever
the Soul
of Brutes is
fancied to
be, it is
void of
Cognition.

XX.
Body is in-
capable of
Cognition.

alter'd, and that it may upon occasion take in, and give back *beat*; that it is *dry* or *moist*, that it gives a *sound* when it is *struck*, or else *deads* the *sound*, that it may *increase* or be *diminish'd* divers ways; and thus you have all that can happen to a *Body*: But what signifies all this to *Perception* and *Cognition*? Certainly to be *Touch'd*, *remov'd*, *Chang'd* in *Figure* or *Shape*, or be heated is quite another thing, from to perceive. Take a piece of *Wax*, give it what *Figure* or *Posture* you please, or let what *Impression* you think fit be made upon it by the most excellent *Engraver* in the *World*; turn it which way you please, shake it, move it up and down with never so much violence, put it into all forms or postures Imaginable, be sure the *Wax* will never complain of any of these ill treatments, or give the least thanks for any of the fine *Figures* impress'd upon it; since all this is done without the least *Cognition* thereof in the matter so handled.

XXI.
Nothing of
Body can
have per-
ception.

All this that hath been said of the *Wax*, is also to be said of any other sort of *Body* imaginable: For any one may very well think that *Wax* cannot perceive all these mutations, in regard it is not *animated*; but that if it had a *Soul* like to that of *Animals*, then surely this *Soul* would without any difficulty perceive whatever could happen in the *body* of the *Wax*; but all this comes not up to the purpose: For if this *Soul* of the *Wax* or of *Animals* were a *Spiritual Substance* like ours, I conceive it would have the faculty of knowing and perceiving the *motions* of any other *Body* near it, or intirely present: But if the *Soul* of the *Wax*, like that of *Beasts*, be a *Corporal Substance*, that is to say, be *Body* it self, one may say of that as of the *Wax*, that it may be moulded into divers *shapes*, that it may receive a world of *Figures*, that it may be capable of *cold* and *heat*, and such like qualities; but that all this together will not be sufficient to cause it to *perceive*.

XXII.
Whether
Matter be
the Cause
of its own
Motion.

Now let us go a little back, and fetch our *Argument* more from the Root of the Business, and shew that *Matter* or *Body* is not only not capable of *Perception*, but also not so much as of producing its own *motion*; for as we have demonstrated in our *General Physicks*, *GOD* is the *Primary* and total Cause of all *motion* in the *World*, and consequently a *Body* cannot give it self any *motion* whatever.

XXIII.
Matter is
passive and
incapable
of all Action.

I am not ignorant that some *Philosophers* will oppose this *Argument*, and not suffer *Matter* to be so undervalued, as to be reputed altogether sluggish, and totally alien from all *Action*; how can it concur, say they, to the constituting of a *Compound Body*, if it be merely passive, and have no other *motion*, but from without? Do not we see the *Atoms* in our *Sublunary Region* to be moved, and spontaneously carried to and fro? Whence proceeds this impulse? What is the cause of this continual agitation? What but a certain inbred Power of *matter*, by which it determinates it self to *motion*, and according as occasion requires, agitates and winds it self? Who can deny but that the *Heavy Bodies* descend of their own accord? That a *Bent Bow*, when the obstacle is removed, springs back, and returns to its pristine State? But what invisible Agent is it that here interposeth, and comes to restore a bent *Stick* to its former place? If therefore *Matter* be capable of *action*, and hath

in it self a power of agitating, and moving to and fro; what should hinder but that it may obtain a power of perceiving, and by a certain impression of the Great Creator, being furnish'd with certain *Organs* fitted for that purpose, may *think*, *apprehend*, *imagin*, *remember* and *exercise* all other functions of an Intelligent Nature?

I am sufficiently assured that I have comprehended in brief whatever can be alledged against the inactivity of *Matter*: So that I have nothing more to do but to invalidate these *Reasons*, and to make good that *Matter* is only an *Unactive Mass*, and no less incapable of *Motion* than of *Cognition*. All *Philosophers* that know any thing of the Nature of *Matter*, know that it is only *potential*, and that it differs chiefly in this from an *Intellectual Thing*, namely, that this last is *Actual*, the other *Potential* only, that is to say, if the *thing* be well understood, that it is only a dead sluggish Lump, and void of all Activity. For this is the difference between a *thinking* and an *extended Substance*, namely, that *Cogitation* is always present to the *mind*; whereas *Motion* is never contingent but to a *Body*, and that while it is impelled by an *External Agent*, and borrows the power of moving another *Body*.

XXIV.
Matter is
only Potent-
tial, not
Action.

But because *Aristotle's* authority hath been always held in high esteem, and all *things* that have been quoted or excerpted from his *Writings*, look upon as *Oracle*; it will not a little conduce to the establishing of our assertion to declare the said *Philosophers* Opinion in this matter: And first in his Book of *Generation* and *Corruption*, he acknowledges the *Matter* is bare of it self, and only *passive*, unless some *External Agent* intervenes which actuates it, and from which taking impression it cannot be hindered from both moving it self, and exciting to *motion* some other *Body*: Also moreover in the same Book he affirms, in several places, that to suffer, and to be moved, are proper to *Matter*; but that to move and to actuate are from a power without: Also in the Third Chapter of his First Book of *Metaphysics*, where he more exactly inquires into the Original Cause of *Motion*, he sharply reproves the *Antients*, for that in their *Physicks* they considered *Matter* only, neglecting at the same time the Primary Principle of *Motion*; and in his *Meteorologies*, explaining his Opinion more clearly, he affirms that neither *Form* nor *Motion* do belong to *Matter*; but only so far as they are impress'd from without. Nor will it suffice to answer, that *Aristotle* spoke here only of *Matter* in common; forasmuch as he absolutely makes his Discourse of Particular *Bodies* indued with a certain *Figure*, which generally in *Physicks* are called *Bodies Natural*; and in express words and terms labours to demonstrate, that no *Natural Body* hath a *motion* from it self, and that *Animals* themselves which seem to be spontaneously moved, are indeed moved with an external Agent: For when in the Second Chapter of his Eighth Book of *Physicks*, he makes to himself this Vulgar Objection, that an *Animal* at first lying still and motionless, afterwards visibly appears to move and walk, without any appearance of any external Movent: The said *Philosopher* presently replies, that this is false; for we see, saith he, something of those *things* which are innate to the *Animal*, to be always in *motion*, but that of this

XXV.
Aristotle's
Authority
to prove
that Matter
is not
ful.

motion

motion not the *Animal* it self is the *Cause*, but most probably the circumambient *Air*.

XXVI.
An Explan-
ation how
Atoms in
the Air are
moved,
and how a
bent Bow
springs
back.

From which places it evidently appears that ARISTOTLE thought *Matter* to be a Principle purely *Passive*, that it was from an *External Cause*, both that it was moved it self, and that it had power of moving any other *Body*; notwithstanding what is alledged of *Atoms* flying about in the *Air*, and of the *Action* they manifest by passing from one place to another: Forasmuch as the said *motion* is not to be imputed to the *Atoms* themselves, but to a certain *Subtile Matter*, which in our *Institution of Philosophy* we have made mention of, as being in continual *motion*, and entering and piercing into the *pores* of all *Bodies*; and since it is not to be doubted but that a vast quantity of this *Subtile Matter* is contain'd and dispers'd throughout in the *Air*, no wonder if such small and slender *Bodies* as *Atoms*, proceeding from neighbouring *Bodies*, are agitated up and down according to the various motions of the said *Subtile Matter*. By the same Reason is the experiment of the *Bended Bow* to be resolved, in regard that *Elastick Force* by which a *Bow* flies back to its former state, is not to be refer'd to the very matter of the *Bow*, but to the *Aether*, that subtilest of *Bodies*, which entering through the more open *Pores* of the *superficies*, and finding them streighter and streighter as they are more and more inward, forcibly urges its way, and makes a kind of an attempt to loosen those streightned *pores*, by a drawing together of the extremities, so to make its passage the freer.

XXVII.
The Subtile
Matter bor-
rows the
force of its
activity
from the
first Mover.

Now if it be demanded, upon what account then do we deny *motion* to *Matter*, if this most subtile *Aether* we speak of, be not only moved it self, but also have a power of moving, penetrating and impelling other *Bodies*? Hold a little, good Inquirer, and take notice, we do not allow this most *Subtile Matter* to be the Principle of its own *motion*, but the first Mover, namely *GOD*, who from the first instant of *Created Matter* imparted a various *motion* to its parts: And by the same *Action* by which he conserves *Matter*, retains in the *World* altogether the same quantity of impressed *motion*, and preserves it intire.

XXVIII.
There is no
intrinsic
gravity in
Bodies.

No more can the activity of *Matter* be any better defended by the objected *gravity* of *Bodies*, since it is an absurd thing to imagin that there is inbred gravity in *Terrestrial Bodies*, by which they are carried downward to the *Earth*, or have an inclination to be so carried; for thus to imagin what is it else, but to impute *Intellect* or *Understanding*, to things meerly passive, and to attribute to them the *Actions* of the *Will*? For in truth, there is nothing else to be understood by Gravity, but that the *Subtile Matter* interposed between us and the *Orb* of the *Moon*, and by a most swift *motion* roll'd about the *Mass* of the *Earth*, drives all *Bodies* towards the *Center*, and denies them any abode in the *Higher Regions*; so that could the force of this most fluid *Liquor* be taken away or removed; no *Body* would be heavy, and a *Stone* placed in the middle of the *Air*, would hang there and remain in that suspended posture, and never slide downward, unless that subtile *Agent* were at hand to drive it down towards the *Earth*: No *Body* therefore is mov'd by it self, but must be said rather to Suffer than to Act, till

such time as it is forced to remove from place to place.

This also will appear more plainly, if we consider the parts of which a *Material Substance* consists; whether they be *Homogeneous* or *Heterogeneous*: For if they be supposed to be *Homogeneous*, and to be all moved immediately by themselves; in all probability they could never rest, or be so compact one with another, as to keep together, and compose those *Bodies* which daily appear to our *Eyes*; because whereas such a *motion* is innate to the parts of *Matter*, and must necessarily flow from them, they could not possibly coalesce, but would remain distinct from each other, and refuse all consistence: Otherwise if they were able to abstain from that *motion*, and at their pleasure compose themselves to rest, what could we do less than set them free, and acknowledge that things *inanimate* are indued with Counsel and Deliberation? But if the parts of which this *Material Substance* is compild, be *Heterogeneous*, and some of them be active, as GASENDUS thinks possible, and others stiff and void of all capacity of moving, no less confusion would arise in the *World* from this position of Parts, than if all Parts were indued with the capacity of moving, in regard that when those which are invested with this Power, cannot but impel their neighbouring Parts, and those so impelled cannot lay aside their borrowed *motion*, unless by imparting it to other contiguous and less agitated; nor these last lose any thing of their celerity, since it is inbred in them and unchangeable; it follows that the whole Frame and Machin of the *World* would be immediately shattered, not the last particle thereof ceasing from *motion*; whence the Famous Dr. MORE in his *Exchiridion Metaphysicum*, altho' he generally makes it his business to oppose the Doctrine of DESCARTES, yet in this Foundation of *Physicks*, he is forc'd to subscribe to his Opinion, whilst he thus defines a *Body* in general, a *Body*, saith he, is a *Material Substance altogether of it self destitute of Life and all manner of Motion*: Or thus, *Body is a Material Substance incorporated into one by an External Power, and by the same manner participating Life and Motion*; by which words this most Eminent Person gives to understand, that *Matter* of it self is altogether a Slug and void of *Action*.

It having been thus demonstrated, that *Corporal Things* are not indued with any moving Power, and consequently that their *motion* must proceed from elsewhere: It will be no difficult matter now to evince that they are also destitute of *Cognition*, and can by no manner of Right aspire to any kind of *Thought* or *Imagination*. For what affinity can *Extension* have with *Perception*? What acquaintance can there be between *Mind* and *Body*, except that both are equally subjected to the same *Genus* or *Kind*, namely, *Substance*, and each of them equally called *Ens per Se*? But it is sufficiently known among *Logicians*, that the *Species* of any *Supream Genus* do not agree, except in the *Essential Attributes* of the same kind, otherwise they would not deserve to be called the *Principal Species* thereof; and that highest *Genus* would more properly be called an *Interjected Genus*, dividing those *Species* from another *Superiour Genus*. But *Substance* is the *Supreme Genus*, and its

XXIX.
Parts in
Matter,
whether
Homogen-
ous or He-
terogeneous,
cannot
move
themselves.

XXX.
As Matter
is void of
Motion, so
its uncapa-
ble of Per-
ception.

its immediate *Species* are *Body* and *Spirit*, so that they cannot agree except in the *Essential Attributes* of *Substance*, such as are *Ens per Se*, &c. But of the number of these, neither *Perception* nor *Extension* are to be reckoned, since there are some *Substances* which perceive not, and others which are not extended; so that *Cogitation* and *Extension* belong not to *Substance* in general. Now to proceed a little further; That which appears only in *Essential Attributes*, ought to be differenc'd from all others; but *Mind* and *Body* agree not, except in *Essential Attributes*; therefore *Mind* and *Body* differ from all the rest, and are oppos'd to them in those things which have not an ingress into the Nature of *Substance*: For it implies a contradiction, that two things should be united in that very particular wherein they differ and contract an association by that wherein their opposition formally consists.

XXXI. To this Ratiocination no small light will accrew, if it be demonstrat'd that *Cogitation* can by no means consist with *Extension*, and that in this manner: If *Perception* may be attributed to *Extension*, it belongs to it as a thing constituting its *Essence*; or as a *Propriety* which accompanies its *Essence*; or, lastly, as a *Mode* or *Accident* which denominates it: *Cogitation* cannot as an *Essential Attribute*, agree to *Body*, for then it would follow, that all *Bodies* are indu'd with *Cogitation*, and consequently that not only *Brutes*, but also *Trees*, *Stones*, *Stocks*, &c. are indu'd with *Cognition*. Not as a *Propriety* of *Essence*, in regard since *Propriety* is applicative, *omni, soli, & semper*, to every of the kind, to that kind alone, and always: It would thence follow that the *perceptive faculty* would belong to every *material thing*, and there would be no sort of *Body*, tho' never so contemptible, to which *Cogitation* might not be attributed. Lastly, Not as a *Mode* affecting the *Substance*, in regard such is the nature of *Mode*, that tho' a *Subject* may be understood without its *Mode*, yet on the contrary, *Mode* cannot without its *Subject*; but we can clearly and distinctly apprehend *Cogitation*, at the same time secluding all *Corporeal Substance*, nay denying that there is any such thing in *Rerum Natura*. So that *Cogitation* cannot, as a *Mode*, be attributed to *Matter*, and consequently *Cogitation* is utterly a stranger to *Material Substance*.

XXXII. Some there be, who perhaps adhering to the Opinion of HENRICUS REGIUS will maintain that what we have said is only true, so long as no *Existence* yet appears; but nothing less if it be supposed to be in *Rerum Natura*; for then what should hinder but that it may be modified by *Cogitation*, and gain a new denomination by the presence thereof? For altho' perchance one should know for certain, that he carries about him in his Purse the *Effigies* of *Cæsar*, but knows not whether the *Graving* be in *Gold*, *Silver*, or other *Metal*, he may safely affirm that he hath *Cæsar's Image*, tho' no representation of *Gold* or other *Metal* occur to him at the same time. Nay, tho' a doubt should come into his *Mind*, whether any such thing as *Metal* be to be found in the *World*, yet nevertheless it cannot be thence infer'd, that the *Image* of *Cæsar*, and the *Gold* or *Silver* it is graven in, are two distinct things, tho' apart one may understand them to be so. In like manner,

tho' one may possibly conceive *Cogitation* as a thing distinct from *Body*, yet we cannot rightly conclude that they are two *Substances* distinct from each other, induc'd only by this motive, that we can conceive them separately one from the other.

But this or any such like example that may be brought by our *Adversaries*, is so far from favouring them, that it rather makes against them, and strengthens our Assertion; forasmuch as not *Gold*, or any other *Metal* is the Primary Subject of *Cæsar's Effigies*, but *Extension*; that is to say, that the *Gold* in which *Cæsar's Effigies* is *Graven*, is not therefore susceptible of that *Image*, because it is the Nature of that *Metal* to be so; for then *Images* could be made of *Gold* only, and no other *Metal*, but because *Gold* is a *Material Substance*, that is, a thing extended, and in which the *Images* of any *Men* may be impress'd or drawn. On the contrary, this Example makes on our side: For if upon this account, namely, because some one carries the *Image* of *Cæsar* in his Purse, and considers the same in his *Mind*, he cannot therefore imagine that there is such a thing as *Body* in the *World*, and consequently that the said *Image* ought to be the *Mode* of the *Body*: I find not why by the same Reason we may not infer, that *Cogitation* belongs not to *Body*, or is not an *Attribute* thereof, since we can suppose, that there is no *Body* existing in *Rerum Natura*, at the same time that we perceive we think. It appears therefore manifest in the conception of *Cogitation*, that nothing of *Matter* is concerned therein; and that *Body* whatsoever *Figure* it may receive, and howsoever agile, pure or subtle it may be supposed, cannot conduce any thing to *Perception*; for if a *Corporeal Thing* be endowed with *Perception*, and apprehends *Objects* offered, what distinction will there be between *Soul* and *Body*? After what manner will *Animals* differ from *Men*? How will *Brutes* be *Brutes* if they enjoy the use of Reason, and have the same Sense as we; if in the same manner they *Perceive*, *Imagin*, *Judge* and *Discourse*? In vain doubtless *Men* challenge to themselves Rationality, and boast of a *Spiritual Soul*, so long as there is allowed a *Matter* capable of those Functions which belong to *Incorporeal Substances*, and distinguish them from other things.

But methinks I hear Mr. HOBBS crying out, that there is no necessity I should have recourse to an *Immaterial Principle* for the producing of *Cogitation*, since motion it self, or the reaction of one part of matter against the other, or at least a due continuation of the said reaction can as well effect the same. For who finds not in himself that the *Head* is heated, and that all parts of the *Brain* are disturbed and out of order, when a Man is excessively taken up with serious *Contemplation*, or very eagerly confines himself to his Study for a long continuance of time? This certainly would not happen if *Sensation* or *Perception* were not the work of *Matter*, or proceeded not from the agitation and motion of its parts, which being granted, what should gainsay, but that the diversity of *Cogitations* may be allowed to arise from the diversity of the *Reactions* of *Parts* upon each other, namely, while they compress themselves divers ways, and react, and are as it were beaten back upon one another? Whereupon such will be the *Cogitation* of every Particle

XXXIII.
Regius has
Argument
solved.

XXXIV.
Hobbes has
Reason to
prove Co-
gitation to
be a conti-
nual Moti-
on.

as the *motion* produced therein, and as this or that pulsation or pressure shall happen among them.

XXXV.

Hobbes his
Hypothesis
examined
and argued
of Falsity.

Mr. HOBBS would make out something by this Argument if he could, first so far bring us to his Opinion, as to believe that there is nothing substantial existing in the *World* but *Matter*, and that whatsoever is produc'd, is extensive and divisible. For when as it is certain that *Men* are indow'd with *Perception*, and receive impressions of *External Things*, from *Organs* destin'd by *Nature*; were this *Hypothesis* granted, there could not in my judgment, be assigned a more proper cause of *Perception*, than *Reaction* of one part of *Matter* upon another, and variety of *Motion* excited therein: But whereas this *Hypothesis* is altogether false, and it is certain that this *World* contains something thing else besides a meer heap of *Bodies*, and that what is in no wise *Corporeal* makes up a great part thereof; Mr. Hobbes must excuse me for being of a different Sentiment, and totally averse from his Opinion. For according to this *Doctrin*, what should hinder but that *Animals* not only laid asleep in their *Dormitories*, but even their very *Carcases* after the *Vital Flame* is extinct, may be said to be sensible, and to be indued with the power of *Perceiving*, when as they are then no less capable of *Reactions* and susceptible of *Corporeal Impressions*. What should hinder but that the *Eye* of a dead *Ox* may be affirmed to see and perceive *Objects*, being so let in at the Casement of a *Window*, that the *fore part* thereof may look towards the *Floor* and several *Objects* illuminated by the *Sun*; and the *hinder part* the innermost recess, which being all dark, must admit of no other *Light* but what enters by the *Eye*, all the *Tunicles* being taken away at the bottom, and to hinder the humour from falling, an *Egg-shell*, or some other *white Body* applied, by which at the same time one may behold the Image of *External Objects* no less distinctly formed therein, than they are form'd upon the *retin Tunicle* of a living *Animal*, especially if it be prest somewhat more or less, according to the distance. Well may the *Head* ake in serious *Meditations*, and some parts of the *Brain* be in an extraordinary manner disturbed, in regard such sort of *local motions* do only denote that the *Mind*, so long as it is tied to the *Body*, depends upon certain *motions* of the *Body*; and that the *action* of the *Body* intervenes our sensations. So that to make us sensible, it must be required that an *Organ* of some one of our *Senses* be disposed in some such certain way as cannot be done without *motion*: For there is a great difference between that which in our sensations hath reference to the *Body*, and that which belongs to the *Mind*. *Motion* indeed impresses an *External Object*, and the *mutation* of an *Organ* and of the *Brain* relate to *Body*, but that comprehends no *Perception*, because that *Perception* consists not in *motion*, nor in *reaction*, nor in *impression* of *Species*, but in the conscientiousness or internal *Cognition*, which of our selves we immediately perceive, when we are conscious of those things which we do, or which are performed in us: But since such a Conscientiousness is something altogether distinct from *local Motion*, the Essence of *Cognition* cannot consist in *local motion*.

But let us examin a little more closely the Nature of *Matter*, and divide it into *Monades* or the most Minute *Physical Particles*. Next I inquire whether each of these *Monades*, separate from each other, can perceive, or are capable of *Sense*, or the whole Composition only resulting from them? I cannot suppose any one so much a friend to *Atoms*, as to attribute *intelligence* to any one single *Atom*; for who can be so stupid as to believe that the least *particle* of *Matter* imaginable, can be indued with *Sense*, and perceive, and think upon impressions of *Objects* coming from without; but if the whole, consisting only of these *Monades*, perceives, and is indued with *Intelligence*, by what means, or by what artifice can it be brought to pass, that of things insensible, a thing capable of *Sense* should arise? How from the various coition of *Atoms*, which are void of all quality, an *Animal Cogitant*, that is, *Seeing, Hearing, Perceiving, &c.* can result? It is most evident that if when the *Flesh* is prick'd with a *Needle*, one *Atom* feels it not, two, three, four or more will never feel, no more than if an incision were made into the sides of a mass of *Adamants*, or other invulnerable things. And as *Fingers* connext, are separated without pain, so it is most evident that *Atoms* only conjoined with one another, may be divided without any *sense* of *Pain*: And for the better confirmation of this matter, we have *Plotinus* concurring in a high degree: If any one, saith he, shall affirm that the concurrent *Atoms* make a *Soul*, he is refuted by the consention of *Passion*, and the copulation of *Nature*; forasmuch as a thing cannot intirely be one and compatiend of *Bodies* not patient, nor admitting any union, and yet the *Soul* may be altogether compatiend to it self.

The most Famous GASSENDUS, following *Epicurus* in this matter, answers, that one *Atom* is indeed void of *Sense*, but that nothing hinders but that *Nature* commixt after a certain manner, of many *Atoms*, may be capable of *Alteration* and *Sense*, and consequently that it is no wonder if a heap of *Adamants*, and such like *Materials* is not sensible, in regard it is not so composed, nor consists of parts so affected as to obtain the power of being sensible; for he is of opinion, that sensible and insensible differ not much otherwise from one another, than a thing kindled and unkindled; and as we see, saith he, a stick of *Wood* lighted by a *Torch*, and a *Flame* created in a new *Subject*: So what hinders but that a sensible thing may be made of insensibles, and that from dead things, as I may say, living may arise?

For as *Lucretius* saith, as *Living Flesh* is formed of *Bread* or *Herbs*, which are insensible; and as from insensible *Wood*, certain particles may be produc'd, which so long as they are infixt into the substance of the *Wood*, remain unmoved, and as it were stupid and benum'd; but upon the approach of *Fire* to them, are streightway roused and put into *motion*; and being thus disposed into a new way of proceeding, they become invested with a power of giving *Light* and *Warmth*: So it is to be understood that the *Fiery Particles*, so long as they are divided, and lie skulking as it were in the *Bowels* of *Matter*, are quite destitute of *Sense*; but when once they expand themselves, and rally into a state of *motion*, they agitate, ve-

XXXVI.

Not the
parts of
Matter, nor
the whole,
consisting of
those, can
be capable
of Cogniti-
on.

XXXVII.

How a
thing sensi-
ble, accord-
ing to Gal-
sendus, may
be made of
insensible
things.

XXXVIII.
It is repugnant to Reason, that Sense should arise out of Insensible things.

gitate and animate what ever *Body* falls to their Province, and impart Sense and Perception to it.

Altho' we should willingly yeild to GASSENDUS in what he asserts, and grant that the *Soul* is kindled in the *Body* like *Fire*; and that the *Sense* is that part thereof by which it is distinguished from other insensible things, yet still there would be no less difficulty to apprehend how it should come to pass, that since the *Atoms* of *Fire* or *Flame*, being divided from each other, do not perceive, or are sensible they should obtain the faculty of being sensible, or perceiving, when they come into conjunction, and are as it were associated and link'd together. For the grand *Quære* will still be, by what way, or after what manner, out of those mixt *Monades*, Perception should arise, and from their union so great a power should accrew, that those things which before were insensible, should be rendred sensible. Here GASSENDUS is at a stand, and ingenuously confesseth that he cannot conceive, how a *thing wanting Sense* should, being mixt with others, procure *sensation*, and give that perception to others, of which it is destitute it self. Indeed, saith he, we must confess there is little hope of appearance how this thing can be manifested, since either we are altogether deceived, or all human Wit is wholly at a loss to comprehend what the Contexture or Contemperation should be either of this *Flame* to entitle it to be thought the *Soul* or *Principle of Sense*, or of that part or *Organ*, which being animated and vegetated, the *Soul* makes use of to perceive by. True it is, that a little after he brings certain *Examples* to make out the progress, by which sensible things may arise out of insensible; first by the *Fruits* of *Trees*, which of *sour*, become *sweet*; of *unsmelling*, *odoriferous*; of *green*, *yellow*; in a space of time so imperceptible, that at the beginning nothing of that quality which succeeds can be discerned; and for the most part toward the end, nothing of that which was at the beginning; by which he labours to insinuate, that in the like progress of time, that is imperceptible, a thing insensible becomes sensible and perceptive, which was at first void of *Cognition*.

XXXIX.
Gassendus his Examples prove not that a thing Sensible can be made of Insensible.

But these *Examples* of GASSENDUS signifie little, for it is easie to be understood, that *Fruit* whilst it is ripening changes its *Savour*, and that that which was *sour* becomes *sweet*, namely, because the *Juice*, subdued by the adjutant *Heat* is refined, concocted, and strained, by which action the rough *Particles* breaking forth, the digested humour remains, which gratifies the *taste*, and produces a grateful *savour*; and for the *Colour* we may easily enough apprehend how the *Fruit* changes, and laying aside its *Green Colour* puts on a *Yellow*, that is to say, while the *Fruits* are ripening, the percolation is perfected, the parts subdued, the juice purified, which swells, froths and ferments; all which things, since they cannot be without transposition of the *parts*, the *colour* also consequently must needs be changed, and its aspect affect the *Eyes* in another manner than formerly. But we can by no means conceive that many *Atoms* joined together can beget *Perception*, and that from their various Perception a Sensitive Faculty should arise. For since *Consciousness*, as hath been before observed, is included in *Cognition* and *Sensation*, the *Atoms* or *Monades* of *Matter*

cannot obtain such a Disposition, or so enter into an Association one with another, as to produce that affection in the *Body*, as being proper to *Immaterial Substance* alone, and inseparable from it.

Besides, it is very difficult to be understood how *Cogitation* can be received into that *Corporeal Soul* which they call *Igneous*; for either *Cogitation* is received whole, in the whole *Matter*, or whole in several *Monades* or small *Particles*: Or lastly, The several *parts* of *Perceptions* are in the several parts of the *Matter*. If the whole *Matter*, that is, the *Soul* of the *Brute*, admits the *species* of an *Object*, it appears not how the *Senses* can be distinguished in it, since each of the *Monades* must supply the place of a *Sensorium*, and the emitted *Species* be promiscuously effused; for how shall the *Ear* be deputed for the receiving of *sounds*, rather than the *Eye*, if in the whole *Soul* this sensation be received, and every *particle* thereof bears, and is smitten with the undulation of the *Air*? Why should the *Eye* rather than the *Nose* be assigned the *Organ* for the discovery of *Objects* without, if the whole *Soul* by a very swift perception apprehend things far distant, and in every point thereof the *species* of *things* be represented? And so in like manner of other *Senses*. But if the several parts admit the whole *Image* of the *Object*, one point of the *percipient* must needs behold innumerable *Species* of one and the same *Object*, and equal that *Object* by which it is exceeded almost an infinite number of *Senses*, which I think no *Man* in his right *Senses* will allow. For how can it possibly be imagined, that one *Physical Monade*, which is taken for granted to be the least *particle* of *Matter*, should receive the whole *Image* of any expanded *Object*, or variously tinged *Colour*? If lastly each part, of *Matter* answer to each part of *Perception*, the whole *Object* can never be discerned, in regard when each of the parts of the *Percipient* only admits each of the parts of the objected *Image*, there will remain nothing which can perceive the whole *Object*, and make the judgment thereof, no more than if three *Musicians*, singing a *Song* of three *parts* were intent each upon his own *part* only, any of them could hear the part of the other, or be able to judge of the whole *Symphony*.

The *Idea's* therefore of *Perception* and *Extension* are wholly disjunct, so that neither *Perception* can be the attribute of a thing extended, nor on the contrary *Extension* of a thing perceiving; neither doth it any way make for those who believe that our *Souls* die with our *Bodies*; forasmuch as if we grant *Cogitation* to *Beasts* in like manner as to *Men*, certainly we must needs determine that our *Souls* are different from the forms of *Animals*, not so much in *Species* and *Nature*, as in *Degree* and *Perfection*; for if they can remember things past, perceive things present, and provide against things to come, and propose an end to themselves, I see not what is left for *Man*, whereby he can have any *præminence* over *Beasts*, except perhaps that he performs the Functions with greater ease, and in a far more excellent manner; so that it is to be feared, if we should attribute to *Beasts* an intellectual Memory, and a proposal of an end to any thing they do, and a certain reflexion upon any of their own actions, it would arm

XL.
Cogitation can no way belong to a Corporeal Soul.

XLI.
If Brutes perceive, how are Men distinguished from them?

XLII.
God can
create Ma-
chins which
may imi-
tate the
actions of
Brutes.

the Impious against the immortality of a *Rational Soul*.

Now therefore that it is apparent and confirmed by divers *Arguments*, that *Matter* cannot be a principle of *Motion*, and that it is of so obtuse a Nature, that it cannot be conscious of any thing it suffers, or be able any manner of way to perceive any thing, who can be so bold as to deny that the Great Creator of all things, upon whose beck all Created Beings do depend, could have framed such sort of *Machins* as might resemble the same motions, and exert all manner of actions exactly like those which we see performed in *Brute Animals*? That GOD is able to frame such *Machins* is confessed by all Men, and particularly is clearly maintained and proved by the wise and learned St. *Austin*, in his 102^d. *Epistle* in these words, *I wonder you should believe that the sound of the Voice, which said, Thou art my Son, could be so uttered by a Corporeal Nature only, without the mediation of Human Thought, and only by Divine Instinct; and not conclude at the same time, that the Corporeal Species of any Animal whatsoever might not be made in the same manner, as likewise a motion like to that of a Living Creature, by Divine Will, without the interposition of any Animal Spirit: For if every Corporeal Creature be at GOD's command without the Ministry of a Life-giving Soul, so far as that such sounds may be uttered as come from an Animate Body, and by which an articulate form of speaking may be conveyed to the Ear; why may not the like obsequiousness be shewn in this, that without the Ministry of a Life-giving Soul, a Figure and swift Motion, may by the same power of the Creator, be conveyed to the sight?* I will not here repeat what I quoted in the Preface concerning a *Machin* which carried Letters to the King of Morocco. Who can but admire that a portable *Dial* or *Watch*, should by a certain figure of parts, disposition of *Wheels*, *Spring* or *elastick Force* of *Steel*, measure the times, and declare to the least part of a Minute all the Hours of the Day and Night? Who without wonder and astonishment can think of that *Machin* which Sir *Kenelm Digby* affirms he saw in the Mint of *Segovia* in Spain, which was contrived with that Artifice, that every part thereof had its various Offices, and was assigned for its proper Action. One part extends into its due latitude, the Mass of *Gold* or *Silver*, and gives it that thickness which the *Coin* requires; the next to this shapes the *Plate* so distended, and designs the *Stamp*; and having so done, transmits it thus *stamp* to another, from which it receives its *Weight* and due *Figure* according to the *Stamp* impress'd upon it. At length the *Coin* thus perfected, is conveyed into a receptacle built for that purpose, where he, whose Office it is to collect and keep the same, finds all the *Money* ready prepared to his Hand. Who could be otherwise than highly astonished that had seen *Dædalus* his *Wooden Venus*, which with *Rowling Eyes* seem'd to look upon, and take a perfect view of all *Spectators*, and likewise to move up and down with her Feet, and exactly to imitate all the actions of a *Woman*, so that she might be judged by all to be a *Living Creature*, and to have a free faculty of moving from place to place?

Who can but wonder that hears of the *Wooden Pigeon* of *Archytas* the *Tarentin*, which having *Wings* set on it, flew up and down like a *Living Bird*? No less an object of wonder was that *Statue* of a *Man*, framed by *Albertus Magnus*, which moved up and down with distinct *Steps* and *Paces*, and uttered *Words* as articulate as any *Human Voice* could utter. Most wonderful also is that which *Historians* report of the *Norimberg Eagle*, which was so framed by *Athanasius Kircher*, that it flew to meet the Emperor *Maximilian*, and hovering with its *Wings* over his *Head*, accompanied him all the way in his return to the *City*. To conclude, the *Statue* must not be forgotten, which being made by an Ancient *Artist*, and set upon a high *Mountain*, saluted the *Sun* each *Morning* at his *Rising* with a *Hymn*, composed in exact musical *Harmony*. Yet no *Man* can be so foolish as to imagin, that in such like *Machins*, there is any *Soul* or *Cognition* required for the performance of all these things; but on the contrary must of necessity acknowledge, that all operations of this *Nature* proceed from *Figure*, *Order*, and a certain magnitude of *Parts*. Why may we not therefore conclude the same thing of *Animals*, since all their parts may be so fitted and connected that the same circuit of *Blood*, the same vigour of *Spirits* may actuate them, as we find to be in a *Living Dog*, since those various movements, fram'd by *Human Industry*, are effected by the help of little *Wheels* and other *Instruments*, which are but very few in comparison of the almost infinite multitude of *Bones*, *Muscles*, *Nerves*, *Arteries*, *Veins*, and other *Organick Parts* which are in the *Body* of every *Animal*? And therefore no wonder if this sort of *Machin* have more admirable motions than any that can possibly be made by *Human Art*.

But to make out more clearly the similitude between these *Antomata* made by the *Hands* of an *Artist*, and real *Animals*: Let it be supposed that GOD should compose a *Machin* exactly imitating the *Actions* and *Passions*, for Example, of a *Dog*, and place it among other *Dogs*, by what ways and evidences should we be able to discover the true *Dog*, whose movements are thought to be effected by *Cognition* and *Design*, from the *Machin*, whose motions and actions are all produc'd by the disposition only of its *Organs*, and the impulsation of *Objects*? Certainly I think no manner of ways, for that there might be justly assigned to both a like force, like *Ingenuity*, and an equal faculty of *Acting*, *Moving* and *Thinking*. Now to make the matter a little more manifest, let us take into examination what that *Mans judgment* would be, who should live confined in a desert *Island*, and being barred from the sight of all *Animals* which we call *Brutes*, should through the whole course of his life, see no other *Creature* but *Man*, and who at the same time should be addicted to *Mechanick Arts*, and to imploy his time wholly in the making of these *Automata*, or at least to be conversant with those who made it their business to frame *Machinements* of divers sorts; as of *Man*, *Horse*, *Bird*, &c. Let us also suppose that these *Automata* did not only go up and down, eat, breath, &c. but also so far imitate all the motions of *Animals* as to represent their perfect *Species*, in so much that upon a blow given,

XLIII.
Several
Machins
made by
Man to
imitate the
motions
and actions
of
Brutes.

XLIV.
The compa-
rison of a
Living Dog
with the
Automata
made by
Art.

given, they should set up a Cry, and with great noise and tumult betake themselves to their Feet; nay more, should come when they were called; in a word, should do all things which Men are wont to do when they are hurried with passions, and wreath themselves into various motions: Undoubtedly this Man, setting aside all ambiguity, and uncertainty of Mind, would judge such sort of *Machins* to be real *Animals*, and that they *live, move, act, desire, think and know* as we do. As a certain Prince of the *Chineses*, when he first saw a *WATCH*, judged it indued, not only with Life, but also with *Sense and Reason*, in regard of the constancy of the motions which he observed in it, till upon the opening of the *Watch*, the sight of the *Wheels* wound up into motion, discovered the *Artifice*, and awakened him out of the error he had entertain'd.

XLV.
Whether
these *Machins*
can
be called
Animals.

It will be doubtless replied to all this, that should *GOD* frame *Machins* to move thus by *Springs*, however they could not be called *Animals*, since an *Animal* is not a thing which merely moves and makes a noise, for so a *Machin* may easily be made to do, but that it is in the nature of an *Animal* to be sensible, and to perform all its motions by a vital and internal Principle, which hath the faculty of perceiving and being sensible, which Properties can never be allowed to a *Machin*. But the grand matter in dispute is, whether it be in the Nature of *Animals* which have not a *Spiritual Soul*, to think and perceive, and we say no: And that all we observe of *Beasts* is, that they are but *Corporeal Movements*, and so a *Machin* may be; so that to say that these Movements proceed from a principle which perceives and is sensible, is to Divine. Moreover it is impossible they should act in such a manner, at least so far as to be allowed *Souls* wholly *spiritual* as the *Souls* of Man is.

XLVI.
The Error
of those,
who from
the external
form of
the Members
of
Brutes,
imagin
they are
indued
with *Cognition*
like
us.

Hence we may see how gross their Error is, who observing that the Members of *Brutes* differ not from ours in the external form, and that their motions are like to our motions, presently infer that the same principle is common to both, and consequently that there is a *Soul* in us which produceth these effects, and which imparts motion to the *Body*, and is indowed with the faculty of thinking; so that there must needs be a *Soul* in *Animals* which executes the like offices, or which actuates their Members, and is a principle of *Cognition* in them: For say they, it is not to be doubted, but that there is great affinity between divers actions of *Animals*, which gives the youngest capacity occasion to judge that they perform their actions in like manner as we do, and by the means of the *Soul*, have passions alike; that they have an Appetite to things agreeable to them, and an aversion to things disagreeable; that they delight in some Images of Objects, and dread the sight of others: But the truth is, if we come to a strict examination of the matter, and inquire thoroughly what that is which we make the principle of *Animal Functions*, it will evidently appear, that we are led out of the way by a meer Childish prejudice, and that we are prepossessed with this Opinion, only by a natural and unthinking apprehension of things; for if these sorts of *Machinements* were set before our Eyes, we should find no footsteps of Reason in them, tho' never so much resembling the Species of a *Dog* or a *Horse*, or should imitate all their

actions; and hence it is to be concluded, that *Animals* are indeed nothing but meer *Machins*, destitute of all *Cognition* and *Sense*.

Why may not, you will say, the same judgment be given of *Machins*, representing our *Bodies*, since those also imitate *Human Actions*, and have motions as like as may be, to ours; and consequently as we infer that *Machins* like to *Animals* are void of *Cognition*, since we see the same or the like Actions in the *Automata* which are framed after their Species: By the same Argument it might be inferred, that Men also are destitute of *Cognition*, because their motions are altogether like to those in the *Machinements*, as to the external Figure, and it is apparent that *Apes* have all those which appear in Men.

To this I answer, that tho' those *Automata* represent the Figure of Men, and imitate as much as morally can be all our Actions, yet they are to be discerned from real Men two manner of ways; First, because they could never be indued with the faculty of speaking, so as to express their thoughts by words or signs, or to answer appositely to those things of which they might be interrogated, as Men in discourse use to; who by certain signs open their Mind to others, and discover the secrets of their Hearts: For tho' we may fancy a *Machin* made with that Artifice, as to utter, nay distinctly to pronounce certain words which may exactly answer the presentment of Objects, moving its external Organs; as for example, if it should chance to be smitten in some one part, it may act what we mean, and if it be toucht in another part with a lighter Hand, it may say we favour it, and such like expressions; yet never so as to adapt its words appositely, and in a proper stile, so as to answer congruously to all things that may be proposed to it; as we find daily Men of the meanest capacity, and sometimes those hardly in their senses to do. The Second way is, that altho' the motions of such *Machins* are orderly, and sometimes also exceed the motions of the wisest of Men, yet in many things they err, and deviate most from us in those things wherein they should chiefly imitate us. Whence it is manifest, that those sort of *Machins* are not conducted by Reason, nor indued with *Cognition*, but impelled to these performances by the disposition of their Organs only. Whereas Men, tho' never so stupid, nay even senseless, are able to put divers words aptly together, and of them to compose an orderly Speech, whereby they can discover their thoughts, and declare what they design in their Minds. On the contrary no *Animal* is found so perfect, and born under so favourable a Star, that he can approach towards intelligence, or perform any thing that can come near it. All which happens to *Beasts*, not through the imbecillity of their Organs, nor through the defect, nor impotence of forming words; forasmuch as we find by experience, that *Magpies* and *Parrots* are *Loquacious*, and utter human expression, yet cannot speak as we, that is, in such manner as that by uttering certain words, their answers can correspond to our interrogations, and manifest to us that they understand what they utter; whereas daily experience informs, that Men deaf and dumb from their Birth, (and doubtless such Men have a defect in the structure of their Organs more than *Beasts*) yet in the

XLVII.
What difference is
between
Men and
Brutes.

the same manner as we make use of *signs*; nay, and by their own ingenuity find out some ways to make known their *Conceptions*, and discover what they have in their *Minds* to those with whom they converse; which since *Brute Animals* cannot do, it is apparent that they are not only indued with a lesser power of *Cognition*, but are altogether void of *Reason*; and that they not only want *Human Cognition*, but are also destitute of whatever other way can be thought on to express themselves; in a word, that they are *Automata*, and act not by *Choice*, but by meer impulse: And here we are given to understand, how vain the Opinion is of some certain *People* of the *East-Indies*, who think that *Apes* and *Baboons*, which are with them in great numbers, are indued with understanding, and that they can *speak* but will not for fear they should be employed, and set to work.

XLVIII.
The Brutes
cannot discover
their
thoughts by
any signs.

But that *Brute Animals* are indued with no *Cognition*, may easily be demonstrated; for if they could discover to us their *Cognition* by any *signs*, they must of necessity do it by *Speech*, or by some other notes, accommodated to whatsoever obvious *Object*, as namely, variations of their *voice*, or some other *Actions* of their *Body*, which should be concluded on as signs of their *Cogitations*, and such *signs* as should not only signify naturally, but by *design*. But since we can apprehend no such signs in *Brute Animals*, and observe in them only natural signs of their *Passions*, and no moral or designed marks can be discerned in them; we may boldly conclude that *Beasts* are not indued with any faculty of *thinking*. Now the Reasons which induce me to assert, that there are no designed hints in *Beasts* to be discerned, are especially two. The first is, because intimations by design, when they depend only upon the will and pleasure of the thing *thinking*, and borrow their efficacy from the will thereof; it seems morally impossible but that they must be various according to the diversity of *Times*, *Places* and *Persons* concern'd, in regard the *Cognitions* and *Aims* of the thing *thinking*, can have no necessary connexion with the actions with which they correspond. The second is, that if the *Clocking* of a *Hen*, upon notice of a *Kite's* lying in *watch* for her *Chickens*, or the *Outcry* of any other *Animal* were plainly by design; it would be impossible for the *Chickens* or *Young ones*, ever to understand such sort of sounds which are uttered at pleasure, and according to the humour of the *Animals* that uttered them: For tho' the *Young Ones* of the *Swallows* mentioned by *Gassendus* upon the hearing of I know not what noise of the *Old Ones*, presently fled away, and leaving the *Tree*, where they nested, followed the *track* of their *Parents*: For so this Eminent Person relates, viz. that walking alone in the *High-way*, and passing under a low *Bough* of a *Holm Tree*, he spied three young *Swallows*, who sitting upon the said *Bough* as he passed by, could not choose but see him, yet never stirr'd or offer'd to fly away; whereupon passing by the third time, he reached out his *Hand*, as it were to take them, yet still they remained immovable, no sign being given to prepare for *flight*; but when the two *Old Ones* came to the place, and uttered I know not what kind of murmuring tone, they fled in an instant, and with a swift *Wing* betook themselves

to the *Air*. If this chattering were design'd, how could the *Young Ones*, being not long hatch'd, know it? Nay, which is more, and which exceeds all belief, how comes it that *Chickens* newly broke out of their *Shells*, and other *Animals* newly yeaned from their *Dams*, send forth sounds always alike, and imitate the *Speech*, as I may so say, of their *Parents*? These things sufficiently declare that these sort of voices are inbred, and that they are taught by nature to signify and discover their Affections by certain signs.

Hence, as I said before, may be gathered how grossly those Persons are deceived, who, because they observe in *Brutes*, *Motions* like to those in *Man*, and *Organs* also alike, persuade themselves, that there is the same principle of motion in them as in us, and that they proceed alike in both from the *Soul*; so that there must be a like *Soul* assigned to *Brutes*, upon which their motions depend: Contrary to whom we plainly discern that there are in us two Principles of our motions viz. one mechanical and Corporeal, which depends only upon the disposition of the *Organs*, and a continual afflux of *Animal Spirits*; forasmuch as the *Essence* of the sensitive *Soul* consists only in the motive Power. Another spiritual and incorporeal, namely the *Mind* or the *Soul*, which we have formerly defin'd to be a thinking Substance, by reason that all its Nature and Property is placed in *Cogitation*. We have concluded that all motions as well in us as in *Brute Animals*, may flow from a mechanical and corporeal Principle, and consequently that there is no necessity to imagin any *Soul* in *Brutes*, besides the force of spirits and conformity of members.

The thing will more evidently appear, if we briefly, and as it were in transitu make out that all motions in *Man* are mechanically effected, that is, without any impulse of the *Soul*, but only by the help of *Organs* and *Instruments*, as may be performed in a *Machine*, which the more happily to go through with, it will not be amiss to begin from the motion of the *Blood*, because on the circulation thereof depends the animal Life, which upon the ceasing of the said circulation is extinguish'd.

Suppose therefore according to DESCARTES, that in the *Heart* of the *Soul* there is a fire, not lucid, but as it were occult, and not much unlike that which is kindled in *Aqua-fortis* by throwing a sufficient quantity of pulverised Steel, or which is to be observed in fermentations, or as some of the Moderns will have it, that a certain heat is excited by the help of the *Blood* in the *Heart*, not much different from that which ariseth from the mixture of *Oil of Tartar* and *Oil of Vitriol*. But from whatever cause this heat of the *Heart* proceeds, whether from some external calidity, or from some corrosive Salts or sulphureous mixtures acting mutually upon each other; or lastly from the *Blood*, continually circulating through it: Certain it is, that the *Blood* impregnated with heat, must needs be dilated, and affect a larger place. For the nature of heat consists in motion; and its chief property is to expand those Bodies in which it is predominant, and to augment their bulk by division of parts: As appears in *Milk*, *Oil* and other *Liquors*, which being held to the Fire grow turgid by degrees, and are enlarged by the con-

XLIX.
There are
in Man two
principles
of motion,
Mechanical
and Spirit-
ual.

L.
All motions
in all Ani-
mals are
explicated
by a Me-
chanick
Principle.

LI.
The motion
of the Heart
is performed
without the
help of the
Soul.

ceived Fervour; So that when by this latent Fire the Blood wherewith the cavities of the Heart are filled, becomes extended, and is necessitated to possess a greater space, it must pass from the right Cavity into the *Vena Arteriosa*, and from the left into the Great Artery, because these two Vessels are always filled with Blood; and their Orifices which are toward the Heart cannot be closed up. This evacuation being made, however the motion of the Heart never the more ceases, by reason that the Blood, which had been rarefied in both Ventricles of the Heart being broke out through the *Vena Arteriosa*, and the Aorta, that little Blood which still remains in those Cavities, and that which being new, slides into the said Auricles of the Heart, are like the foresaid Liquors, of which one supplies the place of a ferment to dilate and heat the other, and this is the only thing which gives motion to the Heart, and causeth it incessantly to flow, and with wonderful swiftness to be diffused through the whole Body.

LII.
By the same
Mechanick
Operation
the Blood
circulates
through the
whole Body.

But that we may the more easily conceive after what manner this Motion perseveres, and how the Blood, during Life, is carried from the Heart into the Arteries, and from them into the Veins, we must imagin that as often as the *Vena Arteriosa* receives the Blood just dilated in the right Ventricle, that very Blood propels other Blood with which it had been repleted before, and causeth it to exonerate itself of a part great thereof, and transmits it into the *Arteria Venosa* into which it flows, not only through those Anastomoses, which are discerned by the Eye, but also through infinite other Spiracles which are in the extremities of the Branches of the *Vena Arteriosa*, and which meet in the extremities of the Branches of the *Arteria Venosa*. It may at the same time be imagined, that as often as the Aorta draws the Blood, which a little before dilated it self in the left Cavity of the Heart, that Blood thrusts forward other Blood contained in that Cavity, and compels it to free it self from that burthen, by driving it into the Branches of the *Vena Cava* into which it penetrates, not only by sensible Anastomoses, but also by innumerable other passages, which are invisible to our Eyes. From such a disposition of the Vessels which contain the Blood, it necessarily follows, that the whole mass of Blood flows about the whole Body, and still returning to the Heart, from which, as from its original Fountain it first sprung, is agitated and forced to move in a perpetual Round. For the Arteries and Veins of the Body are like Rivulets, through which the Blood incessantly, and with wonderful speed flows, taking its course from the Veins into the Arteries through the Ventricles of the Heart, as in Animals, yet living, is manifestly seen; forasmuch as upon the cutting of a Vein, the Blood flows out in an insire Body, and the Veins by degrees become lank, that is to say, the Liquor being let out wherewith they before swell'd. The Blood therefore being impell'd from the extreme parts of the Body towards the Heart, flows through the *Vena Cava* into the right Lobe of the Heart, and then into the *Arteria Magna*, which drives it upwards, downwards, and sideways into the Great Veins, thence into the lesser, and oftentimes into the very substance of the Flesh, in regard the Branches of the *Arteria Magna*, being dispersed through the whole Body,

are knit to the Branches of the *Vena Cava*; which at length carry the same Blood into the right Ventricle of the Heart, in order to begin a new Circuit.

Upon this continual Circuit of the Blood depends the Pulse of the Heart and Arteries; for since these two are no other than a Species of alteration which is perform'd by turns, and in such a measure that the Pulses of the Arteries answer to the Pulses of the Heart; it may be easily concluded, that those motions proceed both from the same principle, and consequently that that principle is no other than the very Alteration which the Blood undergoes in the Heart. Wherefore it is most rational to believe, that as often as any portion of the Blood falls into the two Cavities of the Heart, it mingles it self with another portion, which was there remaining before; which filling the inmost recesses of the Ventricles of the Heart, gains there a new degree of heat, and as hath been already hinted, gains a certain nature, as it were, of a Ferment; whence it comes to pass, that the substance of the Heart is forced to dilate and extend it self. Afterwards a greater portion, which was included in those Cavities, breaking forth through the Aorta and *Vena Arteriosa*, the Heart falls in and stretches its Longitude. And in this perpetual mutation of the Figure of the Heart its motion consists. The Diastole or Dilatation of it is when the Blood being rarefied within its Ventricles, the Mucro or point is drawn in towards the Base; the Systole or Contraction is, when the Blood being expelled, the Heart falls in, and comes to its proper shape; for the Diastole and Systole of the Heart are no other than its Intumescence and Subsidence, that is to say, as the Blood by turns thrusts forward and retires, the Heart alternately swells, and is deprest.

The Pulse of the Arteries follows the motion of the Heart, and consists chiefly in this, that by the Blood dilated in the Heart, and insinuating by a motion of Vibration through their Tunics, they become inflate, as may be experimented in opening the Breast of an Animal, yet respiring and labouring for Life; for at the same instant wherein the Finger put to the Artery is impell'd, the Mucro or Point of the Heart is withdrawn to the Basis, and its Flaccid sides which are toward the right and left Ribs, are lifted up towards the *Mediastin-wall* of the Heart; and the side of the Heart which is directed towards the Stern, is totally, but especially at the Basis erected, and so the Heart is sensibly inflate and extended, beats the Breast, and begets a sensible Pulse; but the Arteries abate of their swelling whilst the force of the Blood is remitted, that is, some part of its agitation being lost, because then the Arteries sink and return to their pristin state, which may be discerned in the Breast of an Animal yet breathing, and especially being near the last gasp; for at the same moment in which the Artery ceaseth from its impulse, the side of the Heart which is towards the Stern appears to sink, and all its substance to become soft and flaccid, from whence it is apparent, that the circulation of the Blood is attendant upon the motions of the Arteries, and that this motion is reiterated as often as new Blood makes its ingress into the Heart, and is varied according to the diversity of qualities found in the Blood, which render

LIII.
Whence
arise the
Pulse of the
Heart and
Arteries.

LIV.
Upon the
motion of
the Heart
depends the
Pulse of the
Arteries.

der it susceptible of a quicker or slower motion.

LV.
That the
Animal
Life, as al-
so the con-
coction of
Meats de-
pends upon
a Principle
only Corpo-
real.

If the *Animal Life* depend upon a *Mechanick Principle*, if the motion of the *Heart*, the pulsation of the *Arteries*, the flux of the *Blood*, and its circuit through the whole *Body* proceed from a corporal and mechanick Cause only, what hinders but all other motions, for example, the Concoction of *Meats*, *Nutrition*, *Respiration*, and the like, may be attributed to the same Principle; when as we see that all these things, without any of our Labour, and even Sleep, are performed by the Functions of the *Soul*, and require no immaterial Cause to their assistance? For what is there of the *Mind* or of *Spiritual Substance* that intervenes in the business of Chylification, whether in the first or second Concoction of the *Aliment*? What happens in *Meat* converted into *Chyle*, which may not be performed by conformation of the *Members*? The *Meat* well chewed and macerated by the *Spittle*, is conveyed into the *Stomach*; by whose means? Certainly by no other means but of the *Tongue*, and the *Oesophagus* or *Wind-pipe*; the first of which having turned the *Meat* up and down some time in the *Mouth*, and being as it were the *Hand* of the *Ventricle*, commits it to the *Mouth* of the *Oesophagus*, and by a certain force casts it in; the latter by the help of its *Fibres*, contracting it self after the manner of an *Earthworm*, swallows the ingested matter, and conveys it farther in; but in regard the *Meat* is but lightly shred by the *Teeth*, and there ought to be a further dissolution of it in the *Stomach*, so as to reduce it into *Chyle*, there is an acid and piquant humour, which issuing out of the *Arteries*, slips into the *Stomach*, and finishes the work begun in the *Mouth*. For since there are many Branches of the *Arteries*, which terminate in the interior superficies of the *Ventricle*, a great quantity of the foresaid humour distills through them, which being mingled with the *Spittle* wherewith the *Meats* are macerated, helps their digestion, and also brings it to perfection, the said *Liquor* being as it were a certain Species of *Aqua-fortis*, which getting in among the particles of the *Meats*, swallowed and eaten, help their dissolution, and makes a *Chyle* out of them. The *Meats* thus digested, slip towards the *Intestines*, where the *Chymosis* and *Hamatosis*, or second and third Concoction may be said to be performed, because the *Gall* which flows into them, and which imparts a colour to the *Meats* as soon as ever they pass out of the *Ventricle*, puts the last hand, as we say, and brings to perfection that which only was begun by the foregoing *Liquors*.

LVI.
How San-
guification
is made in
the
Body of any
Animal.

The *Meat* thus dissolved into *Chyle*, as soon as it hath gently and gradually flow'd through the *Intestines*, is pressed forth, and is conducted through the *Lacteal Veins*, which running out in small but almost innumerable *Pipes*, receive the *Liquor* as it grows white, and convey it into that which is called the *Pecquetian Receptacle*, so called, because *Dr. John Pecquet* in his Book which he wrote concerning this matter, challenges to himself the first invention of it; from which Receptacle other *Chyliferous Pipes* arise, which proceeding directly upward through the *Breast* it self, conduct it onward to the *Subclavian Branches* of the *Vena Cava*: From whence the *Chyle* running at that very place into the *decurrent Blood*; and being well

mixt therewith, and passing through the *Vena Cava*, as well above as below, enters the *Heart*; where by a fermentaceous effervescence there excited by the heat of the *Heart*, it changes its colour, namely, from *White* to *Red*, whence appears the falsity of that opinion received by the *Antients*, namely, that the *Blood* is wrought in the *Liver*, and that the *Chyle* is carried through the *mesaraic Veins* in the *Mesenterium*, so into the *Vena Porta*, and from thence into the concavity of the *Liver*, where it is peculiarly fermented, and as the *Chymists* call it, digested and separated from the admixed *Choler*, and turns into a *Red Juice*; when as indeed no part of the *Chyle* at all arrives so near the *Liver*, as that it can thereby be changed into *Blood*: For how can it be, that the *Liver* should create *Blood*, and bring a redness upon the *Chyle*, when not the least part of the *Chyle* is ever conveyed thither, and it hath been sufficiently made out by innumerable dissections of *Animals*, that it passeth through the *Subclavian Branches*, and is by them infused through the shortest Trunk of the *Vena Cava* into the *Heart*.

These things have undesignedly slipt my *Pen*, my intent being only in this Discourse to describe in a few words the *Oeconomy* of *Animals*, and to evince, that all the functions of the *Body* may be mechanically explained. Let us therefore follow the tract of the *Blood*, and go on according as we are led by the course thereof. The *Blood* being rarified in the *Body*, and going out with a force into the *Arteries*, it cannot be otherwise but that many particles thereof must make a stop in those members which they are nearest to, and there possess the place of some parts which they thence expel, and according to the figure, situation or exility of the *Pores* which they find, cause some parts rather than others to flow into certain places, in a manner not much unlike what we see done by some sort of *Sieves*, which in regard they are contrived with holes of a different kind of bore, serve to separate from each other *Grains* of *Corn* that are of various Species: or as the same *Rain* adapts it self to *Plants* of a different kind, and in *Mustard*, grows sour; in *Rue*, bitter; and in *Liquorice*, sweet; so the *Blood* being diffused through the whole *Body*, transmutes it self into the substance of every part, and is dispens'd according to the diversity of their *Pores*, and agglutinated by a certain streight Union. I have said that the particles of the *Blood* stop in the members to which they are nearest, and possess the place of others which they thence expel, because it cannot be doubted, as experience teacheth us, but that there is a continual transpiration of sensible parts through the pores of the *Body*, and that some particles are ejected. For, if we consider the thing well, saith the Famous *Glisson*, in his *Anatomy* of the *Liver*, we breathe out almost as much again as we take in; and when any one breathes upon a *Looking glass*, a little *Cloud* is left upon it in the nature of a balmy dew: And as to what concerns the other parts, if by the inner part of the *Thumb* a little warm, a Plate of *Polish'd Silver* or *Peyster* be touch'd, the *Vapour* thence breathing out, will presently leave a spot upon the *Metal*: And to him that considers well, that the same expiration is made from all parts of the *Body*, *Sanctorius* his Calculation will not seem much from the purpose who

LVII.
The Nutri-
tion of Ani-
mals is
made by
the Circu-
lating of
the Blood
through the
whole Body.

who upon trial made of his *Observations* in this matter, affirms, *that of all we eat and take in, more than a half part is consumed by insensible Evaporations*; nay, and that as much of *Aliment* is voided in a day through the *latent pores* of the *Skin*, as by *Stool* in fifteen.

LVIII.
Respiration
is also Me-
chanically
performed.

With the same facility *Respiration* may be explicated, by the same principle; forasmuch as the *Chest* being dilated by the help of the *Muscles*, and especially of the *Diaphragma*, the *Lungs* are enlarged or contracted, and by the means hereof we draw the *Air*, and immediately expel it again with the admixture of *Vapours*: For the *Diaphragma* is a certain *Muscle* dividing the *Breast* from the interior *Ventricle*, of a singular *Nature* and *Fabrick*, and aptly framed both for self-motion, and for impelling the *gristles* of the *Ribs* to which it adheres; whence upon its tending downward, the *Air* must of necessity enter the *Lungs* through the *Trachea*, or *Aspera Arteria* for the effecting of *respiration*; but when the *Diaphragma* ascends upwards to recover its former situation, the *Thorax* or *Chest* is contracted, by which means the *Lungs* are prest, and expel through the *Aspera Arteria*, the *Air* contain'd and kept in; and this is that which is called *Expiration*. Nor is it to be thought, as some will have it, that in *Inspiration* the *Air* enters into the *Breast* for fear of a *Vacuum*; or that it penetrates into it spontaneously, and without any compulsion; for this sort of attraction or spontaneous *Ingress* is a meer *figment*; when as the motion of *Bodies* cannot be performed but by *Pulsation*; for the external *Air* is brought into the *Lungs* for no other cause, but for that the *Cavity* of the *Thorax* is enlarged, and forcibly driven into the *Breast*, because when the nearest *Air*, the *Breast* being unfolded, is expell'd; and because of its thickness, cannot plentifully and speedily enough enter it; Nor, because of the subtle *Matter* intervening and dilating it, be condens'd, it follows that it must needs be driven through the *Aspera Arteria* into the *Thorax*, as we see daily in the blowing of a pair of *Bellows*, where the *Air* is propell'd into its cavity, while the sides are expanded, so that the *Diaphragma* is of all parts serving to *respiration*, the first mover; and from whence, as from the *Fountain*, the motion of all those parts ariseth and depends: To believe which I am chiefly induc'd by this Reason, (tho' I could produce many others of no less moment) namely, that upon the opening of the *Thorax*, presently the *Lobes* of the *Lung* fall in, and for a little space are deprived of all motion, while at the same time the *Diaphragma* nevertheless intermits not its motion, but contracts and extends up and down, and attracts, as *Gassendus* calls it, and moves at once the *Gristles*, and the extreme part of the *Spurious Ribs*, to which it adheres: Whence it comes to pass, that the *Air* is attracted by a wound into the cavity of the *Breast*; so that no wonder if, as the same Author relates, the Wound hath sometimes suck'd in a piece of *Candle* into it, as appears by the relation of *Bogamus* the Surgeon, who in curing an *Empyema*, near to the *Diaphragma*, when the better to make his inspection for the extracting of the putrid matter, he drew asunder the *Orifices* of the wound entring into the *Breast*, and bid the Servant hold a piece of a lighted *Wax Candle*; the said *Candle*

being not held very fast, was snatch'd away, and attracted into the Wound, and not till after eight days space, and the indurance of many grievous symptoms drawn out of the mouth of the wound with much ado; so that by this we may plainly see that it is the *Diaphragma*, which alone contributes to our *Natural Respiration*, when asleep, or ceasing from pains and labour; and that all the *Muscles*, whether of the *Abdomen* or others, do nothing but obey its motion; whereas to a violent *Respiration*, and not *Natural*, and which at pleasure we hasten, retard, restrain, intend or remit, somewhat more than the *Diaphragma* must contribute; since the *Organs* of voluntary motion are the *Muscles*, and consequently both the *Diaphragma* it self is concerned, as it is a kind of *Muscle*, and also other *Muscles* as they attract, lay open, press and urge divers parts to which the *Diaphragma* is tied, or is contiguous.

Besides, the fore said motions of *Animals*, whose *Original* and *Causes* have been already treated of, there is another called *Muscular*, to be made out; namely, that which is performed by the influx of the *Animal Spirits*, and depends altogether upon their action: Which the more clearly and easily to do, we must suppose in the first place, that by the name of *Animal Spirits*, there is nothing else to be understood, but the more vivacious and refined parts of the *Blood*, which being strained as it were through a *Sieve*, through the *Branches* of the *Arteries* called *Carotides*, are separated from the grosser parts, and are thence conveyed through the *Vessels* of the *Brain*; from which they are diffused through the *Nerves* into all the *Muscles*: But why the parts of the *Blood* which bear hath rarified in the *Heart*, should tend to the *Brain*, rather than elsewhere, there is no other reason to be given, than because the *Arteries* which convey them thither, proceed from the *Heart*, by the most streight Line, and are driven directly without any declination into the *Brain*; but according to *Mechanick Rules*, which are the same as the *Rules* of *Nature*, when divers things tend to one and the same place, where there is not space enough, they must betake themselves to any other where they can, because the ways are very narrow, as happens in the pores of the *Brain*, the more subtle and more quick particles alone enter the *Brain*, the rest diffusing themselves through all parts of the *Body*; so that those which do enter, are to be look'd upon as most subtle winds, and purest *Flames*: In the second place we must suppose that a *Muscle* is not only fleshy, that is, of a thin, and as it were *Spongy Substance*, the more easily to receive the *Animal Spirits*, but also many times contain *Nerve*, *Ligament*, *Tendon*, *Membrane*, *Artery* and *Vein*. It consists of *Nerve*, as of a certain *Canal*, through which the *Animal Spirits* are deduc'd into it from the *Brain*, and the *Medulla Spinalis*: Of *Ligament* to render it the stronger, and be able to resist the incumbent *Members*, and to exercise its motions the freer: Of a *Tendon*, that it may perform its motion the more promptly, and regulate its actions the more strongly: Of a *Membran*, lest the fore said parts of the *Organ* of *Motion* being deprived of a *Covering*, should be exposed to the injuries of *External Bodies*, and lest the *Animal Spirits*, being entred into its substance, should be dissipated, and evaporate by *Transpiration*: Of

LIX.
That there
are ani-
mal Spi-
rits, and of
what parts
a Muscle
consists.

Venus

Veins and Arteries, thereby to supply it with *Aliment* and *Vital Heat*, by the influx whereof all the *Members* of the *Body* are enlivened and corroborated.

LX.
What a
Muscle is,
and why
the Anci-
ents distin-
guish it in-
to Head,
Tail and
Belly.

Ancient *Anatomists* described the *Fabrick* of a *Muscle* by a distinction of *Head*, *Tail* and *Belly*, taking for the *Head* of the *Muscle* the *Extremity* joined to that part, at which the contraction is made; for the *Tail* of the *Muscle*, they took the end or portion inserted into that part which causeth motion; and lastly, they called the *Belly*, that intermediate part of the *Muscle*, which appears more tumid than the *mass* of *Flesh*. But we may further observe that a *Muscle* is, as the Famous *Willis* hints from the most *Learned Steno*, either *simple*, which consists of one only *Ventricle*, and two *Tendons*, of which sort there are several in the *Arm* and *Leg*, which are the *Movers* of the *Fingers* and *Toes*; but they are also frequent up and down in other parts of the *Body*; or *Composite*, which hath several *Ventricles*, upon each whereof there hangs two opposite *Tendons*, yet so, that where-ever the *Tendons* are *Composite*, that is to say, two joined together, one *Composite Tendon* may enter the middle fleshy parts, and the other surround the middle fleshy part on each side; as most apparently is seen in the *Muscle* called the *Masseter*, the *Deltoides*, and some others; in all which in like manner, as in the *simple Muscle*, two *Fleshy Fibres* (to which alone the *Motive Power* belongs) are contracted, and the opposite *Angles*, according to the insertion of the *Tendons* are enlarged, and thereupon the *Ventricles* becoming shorter, and at the same time grosser, rise into a *Tumour*.

LXI.
The Motion
of the Mus-
cles is made
by the help
of the Ani-
mal Spirits.

These things thus briefly, and by the by explained, we infer that the motion of the *Muscles* is made in general, while the *Animal Spirits*, being swiftly moved, and like the parts of *Flame* shooting out from a *Brand*, being conveyed into the *Muscle* by the conduct of the *Nerves*, and there copiously laid up, as in their proper *Promptuaries*, and dilating themselves by their agility, enter into the *Carnuous Fibres*, and become inflate, because then the *Muscle* contracted and expanded in Latitude, draws that part into which it is inserted, towards the *Head* of the said *Muscle*; but when the *Spirits* retire into another place, the contraction is at an end; and the *Muscle*, formerly more contracted, becomes longer, and is restored to its pristine position: So that the only cause of all the motions of the *Members* which are performed in an *Animal* is, because certain *Muscles* upon the *Spirits* emanation, are contracted, and those which answer them on the adverse part, by the departure of the said *Spirits*, are dilated and extended.

LXII.
How it
comes to
pass, that
when one
Muscle is
contracted
another is
dilated,
and so con-
trarywise.

But if it be ask'd why this *Muscle* should be rather contracted, than those which are opposite to it, and all the *Fleshy Fibres* of one *Muscle* should be drawn into wrinkles, and be more tumid and rough than those of another? I answer, that it so falls out, because more *Spirits* flow to this than to the other, so that they render it shorter, grosser and broader. Not that the *Spirits* which immediately proceed from the *Brain*, are sufficient to move these *Muscles*; but because they dispose other *Spirits* which are already in these two *Muscles*, to pass out of one of them into the other; by which means that from which they pass becomes longer

and more remiss; and that which they enter into becoming soon inflate by them, is contracted, and draws along with it the *Member* to which it is knit, which may easily be conceived, as *Cartesius* observes, if it be but seriously considered, that there are but very few *Animal Spirits* which proceed from the *Brain* towards any one of the *Muscles*, but that there are always many others included in that very *Muscle*, which *Spirits* are moved therein with a very swift motion. Sometimes by moving only circularly in the place wherein they are, that is, when they find no open ways to get out at, and sometimes by flowing into the opposite *Muscle*, because the *Apertures* are small in every one of these *Muscles*, by which the said *Spirits* may flow from one to the other, and are so disposed, that when as the *Spirits* which pass from the *Brain* towards one of them, have a little more force than those which pass towards the other, they open all those *Orifices* by which the *Spirits* of this may have a passage into the other, by which means all those *Spirits* formerly contained in these two *Muscles*, gain a very speedy *Conflux* into one of them, and so puff up and contract that, while the other is extended and remitted.

And that *Animal Spirits* have this efficacy, is most evidently evinc'd from their agility and mobility; forasmuch as in the twinkling of an Eye they pass through the whole *Body*; and having in some sort obtained the Nature as it were of an *immaterial Soul*, are carried with a most wonderful swift force into the *Muscles*, and in a moment induce a change of Figure into the *Members*. Hence *Galen* in the 13th Chapter of his First Book *De Motu Musculorum*, There is, saith he, in the *Ventricle* of the *Brain*, a *Spirit*, the first Instrument of the *Soul*, by which the *Soul* transmits both sense and motion through all parts of the *Body*. In the second place we see in our selves, that no action of *Life* is performed, but by the help of the *Animal Spirits*; and hence it is that a Man having his *Spirits* exhausted, faints and languishes: Likewise hence it is that the passage of the *Spirits* being obstructed, the *Apoplexy* and *Palsie*, nay, the *Epilepsy* and *Vertigo* also arise: Also hence it is, that by a too intense study, the *Head* is debilitated, and a great dissipation of the *Spirits* follows. In like manner as in a vehement motion of *Passion*, there is a perturbation of the same. Thirdly, The influx of *Animal Spirits* is plainly represented to the *Sense*, by a *Snail* inclosed in a *Glass Phial*, as *Henricus Regius* observes; for as soon as she begins to make her progress, first some, and then other *Spirits* with conspicuous *Bubbles*, are continually driven on from the *Tail* to the *Mid Body*, and thence to the *Head*; but as soon as the said *Snail* stops her progress, and lies still, immediately the motion of the *Bubbles* from the *Tail* to the *Head* is also stop'd. Moreover, in the motion of the *Snail* there seems to be a certain circulation of *Spirits*, passing from the *Tail* by the *Belly* to the *Head*, and returning from the *Head* by the *Back* to the *Tail*, being thence again to take their progress as before.

Now if any one should object, that there seems not to be so great a force in the *Animal Spirits* as to be able to move the whole *Body*, since in regard they are the most subtle parts of the *Blood*, how should so great a force come to be in so very

LXIII.
The Force
and Efficacy
of the Ani-
mal Spirits
in moving
the Muscles.

LXIV.
How there
should be so
great a
force in the
Spirits as to
move the
whole Body.

thin a matter as to stir up and down, not only the *Leg* or *Arm* of an *Animal*, but also to Move, Govern, Heave and Carry from one Place to another the whole *Machin* of the *Body*? Who can be made to believe, that so great a *Body* as that of a *Bull* or *Elephant* can be impell'd by so thin a substance, and be disposed and excited to so swift a pace; nay and sometimes to a kind of *Dance*? I answer that this needs not seem strange at all, if we do but remember that the *Animal Spirits* have been already proved to be in the Nature of a most pure and subtle *Flame*, whose force appears no less in the *Body* of an *Animal*, than in *Fire* stirr'd up by *Gunpowder*, which being inclos'd in a *Great Gun*, or *Piece of Ordnance*, causes it, tho' a thing of that massy bulk and weight, to recoil a great way backward, and sometimes to burst; and with that force to shoot out and drive into so swift a motion a weighty *Bullet*. Since therefore an *Animal* is a sort of *Machin*, and all its motions are *Mechanically* performed, it must act according to the manner of other *Machins*; for example, *Bars*, *Wedges*, *Scales*, *Pullies*, *Cranes*, and the like, by which a small help or stress being added, things of great bulk and weight are lifted and remov'd.

LXV. There are two sorts of that *Engin* they call *Vectis*, saith the most learned *Gassendus*, which because they draw up Burthens by *Cords* and *Ropes*, they have the more peculiar Analogy to the *Organs of Motion in Animals*, forasmuch as one of the principal Motions is attraction, which is made by *Tendons*, as it were by *Cords*: Of these two sorts of *Vectis*, the *Trochlea* or *Pully*, than which there is nothing more known, and *Tympanum* or *Peritrochium* which is also very much in use, that is to say, when the *Axis* or *Cylinder* being fixt to it at one end, and in another part sustained by two Props upon which it may be turned, it winds about it self the *Cord* fastned to it at one end, and drawing up the Burthen by the other, is turned round by *Pegs* fixt into it all about this *Machin*. The *Latins* call a *Sacula*, a *Crane*; the *Vulgar* *Tornus*, a *Torn*. In the *Trochlea*, the Diameter of a small *Orb* supplies the place of the *Vectis*, which bearing upon a little immovable *Axis* as its *Hypomocion* or Underpropper, obtains a power of presson in that end where the *Cord* press by the Attractor, urges most; and because the Burthen makes its stress upon no other extreme, but is tied to the uttermost *Cord*, it thence comes to pass that while that extreme gives way to the pressing power, or is lifted up; that part also of the *Cord* to which the Burthen is tied, is at the same time lifted up, and another Diameter, that is, another *Vectis* or *Bar*, and after that another immediately succeeds, and thus the attraction or lifting up of the Burthen is brought about; whereas in the *Tympanum* or *Sacula*, every *Scutula* or *Peg* is apparently a *Vectis*, in the extreme whereof the force is incumbent from the *Hand*, deducing or drawing down; and whereas the *Fulciment* or *Prop* is allowed to be in the *Cylinder* it self, another extreme *Fulciment* must be allowed to be at the adverse part of the *Cylinder*, upon which in regard the Burthen makes no stress, but hangs upon the main *Rope*, it thence comes to pass, that while that gives way, the *Rope*, is wound about the *Cylinder*, and being still shortn'd

as it winds, lifts up the weight, and this is continued by *Pegs* or *Bars*, continually succeeding one after another: Now in an *Animal* there are not indeed such things as *Trochleæ* to be seen, but to supply their place, there are so many as it were *Corrugations*, by which the *Tendons* are contracted, and the *Muscles*, themselves abbreviated as to *Longitude*. So that from them proceeds as it were a certain Series of *Trochleæ*, in imitation of the *Polyplastie*, whose force is wonderfully vast; nor doth there appear any *Circumduction* or Winding about, in regard the revolved *Tendon* is shortned, nevertheless there is that which supplies the place thereof; namely, the *Contraction*, and as it were *Complication* of the *Tendon* upon it self, by the help of the *Animal Spirits*; whence it follows, that the part contracted comes nearer and nearer to the Head of the *Muscle*.

From this similitude of the *Vectis* with the *Machin* of an *Animal*, and from the manner by which we have above made out, that the functions of the *Body* are performed; it is clear enough evinc'd, that there is no necessity of a *Soul* in *Beasts*, for the producing of a Pulse of the *Heart* or *Arteries*, the Concoction of *Meats*, *Nutrition*, *Respiration* and *Procreation* of *Spirits*; but that they are produc'd without any *Cogitation*, and consequently that the parts of the *Body* in *Animals* are moved from place to place, in the nature of *Pneumatick* or *Hydraulic Automata*.

This hinders not but that the motions which are performed by the help of the *Muscles*, and influx of *Animal Spirits* are various, and not always excited in *Animals*; for example, that *Beasts* walk sometimes with a swift, sometimes with a slow pace, that they turn this way or that way, &c. Since this diversity of motions argues not any *Cognition* in them, as if they had any design in what they did or understood, what to Fly from, or what to Follow after, but because they are of such a Constitution and Fabrick that the *Pores* in their *Brain* are opened sometimes one way, sometime another, and their *Spirits* have a different influx into various *Fibres*, *Nerves* and *Muscles*, according as the *Organs* are moved by the *Objects*, and suggest manifold *Species* to them: For example, if a *Dog* be benum'd, or seiz'd by Cold, or any bad Weather, seeing a *Fire* a far off, he makes haste to come to it, not induc'd by any other reason, but because such an *Object* as that opens the passages of the *Brain* which terminate in the *Muscles* of the *Legs*, and so the *Animal Spirits* are transmitted to them, which causes him to approach near the said *Fire*; and being thus arrived, and finding the kind and grateful heat thereof; there ariseth thereupon such a commotion of *Spirits* in the *Brain*, that immediately they direct their course into those *Muscles*, which is the cause that he makes his stay there and lays him down to repose and cherish his benumbed *Members*; but if it chance that when he is thus laid, and inclining to *Sleep*, the *Fire* should be over-hot and scorching, or a Spark should shoor out from a burning Coal, and leap upon his Skin and burn him, this agitation of the singeing heat immediately opens those *Pores* of the *Brain* which draw down to the *Muscles* of the *Neck*, *Eyes* and *Feet*, and attend their motions; so as that he presently rouses himself, looks upon the *Fire*, and with a swift pace retires from it. Or if the Master

LXVI.
It is concluded that
Animals
are mere
Automata.

LXVII.
Whence the
diversity of
motions in
Animals, if
they have
no Soul.

of the House by chance, from abroad comes home, and comes in view of the *Dog*, immediately upon sight of him, the passages of his *Brain* are open'd, as by custom so disposed, in so much that he directs his course to his said *Master*, and testifying his joy by wagging his *Tail*, fawns upon him. But if a *Stranger* enters, whose Countenance and Habit of Body are unknown to him, his Aspect and unwonted Scent he brings along with him, stir up the *Dog* to a contrary motion, by opening those *Muscles* which attend upon his Barking-fit, and conduce to the warfare of his *Teeth*, and stirring up of his Anger; so that all the motions which are performed by a *Dog*, are excited by *Objects*, which being received into the Sensories, dispose the *Spirits* to an Influx into several parts of the *Body*, which are adapted and conducive to move them,

LXVIII.
In Man al-
so many
motions are
effected
without the
concur-
rence nay,
against the
consent of
the Soul.

The *Peripatericks* ought not to be troubled, that we attribute the motions of *Animals* to the disposition of their *Organs* only, and make out all their sensible actions without any help of the *Soul*, when as if they would seriously inspect into themselves, and consider well what is done within them, they would find the same thing altogether in themselves: For who is there that is not taught by experience, that various motions daily arise in his *Body* without any concurrence; nay, oftentimes against the *Will*, and with the reluctance of the *Soul*? In *Convulsions* or the *Colick Passion* some part of the *Abdomen* are twitch'd, whence an acute Pain arises, the *Bellows* are contracted, and the *Navil* is drawn in: Often-times the *Intestines* by an inverse motion of the *Fibres*, are pulled upwards, the *Ureters* and *Urinary Vessels* are so impelled one against the other, that in the whole *Fit*, *Urin* is either totally suppress'd, or is voided very sparingly and by drops: All this while no Man certainly will maintain, that the *Soul* connives at these motions, when he that suffers such grievous *Maladies*, cannot but most earnestly with himself free; and there is no Man but must vehemently complain of *Pain* during the *Contraction*, *Inflation* or *Astriction*. The same might be demonstrated in a world of other Examples, but let these few suffice, that we may not seem to dwell too long upon a thing perspicuous enough of it self. They that fall down from any high place, fall so that their *Hands* come first to the *Earth*, so as thereby to save the *Head*; and this they do not any way consulting, but because the sight of the impending fall, reaching to the *Brain*, directs the *Animal Spirits* into the *Nerves* in such a manner as is necessary to produce this motion, as it were in a *Machin*. Likewise if any one unexpectedly should hold up his *Hand* towards our *Eyes*, as it were offering to strike us, tho' we were sure of his *Friendship*, and well satisfied that he did it but in *Jest*, and designed nothing less than to do us a mischief; yet we should hardly refrain from shutting our *Eyes*: Which evidently shews, that this shutting of them is not any work or design of the *Soul*, since it is done against our *Will*, and our *Will* is the only, or at least principal action, but because the *Machin* of our *Body* is so compos'd, that the motion of the said *Hand* to our *Eyes*, excites another motion in our *Brain*, which draws down the *Animal Spirits* into those *Muscles* that let down and depress the *Eye-lids*.

The same thing is to be supposed of other motions of the *Body*, for upon the sight of any delicate or enticing *Meat*, not only the innermost *Jaws* are moved with a desire thereof; but the *Tongue* and *Palate* being moistned with *Spittle*, cause a certain, as it were *præmansion* or fore-chewing, as we may so call it: So that this sort of *Meat* is the occasion that the *Spirits* direct their course towards those *Muscles* which are inservient to the *Jaws*, *Tongue* and *Palate*, and contribute motion to them. The same is to be said of *Itching* and the *Venereal Motions*, which upon the sight of any *Venereal Object*, are excited in those parts that conduce to the performance of this Scene.

For doubtless if all the motions of our *Body* depended upon our *Will*, and we could govern our *Members* at pleasure, there would certainly be found no *Paralyticks*, or Persons troubled with a *Palsie*; none deprived of motion all the *Body* over, or in any of its parts. Forasmuch as there is no Man, in whom there is not a *Will* to move his own *Members*, and free himself from that resolution or untying of the *Nervous Parts* which takes away *Sense* and *Motion* from him. Who would suffer the use of any of the parts of the *Body* to be taken from him, if it were in his power to open the Obstructed Passages, and make way for the *Animal Spirits*, by which they may be transmitted, and may influence, plump up and actuate with vigour the *Nervous Parts*?

Now there are not only *Natural Motions* which are performed in us without the help of our *Knowledge* or our *Will*; but there are also a world of those which they call *voluntary* or *spontaneous Motions*, which are effected by the disposition only of the *Machin* of the *Body*, without any thought or design contributed thereunto by our *Soul*: For if, while we think upon any other thing, a spark of *Fire* chances to light upon our *Hand*, we presently start back with all imaginable swiftness, there needs no deliberation for so doing, our *Will* not being concerned in this motion, our *Hand* is drawn back before we can have so much as a thought thus to snatch it away.

If we have a mind to stoop for the taking up of any thing upon the *Ground*, we draw back one *Leg*, so to give us the better advantage to counterpoise the rest of the *Body*, which hereupon leans forward: If walking upon a dangerous path, we chance to slip, we immediately lift up that *Arm* which is opposite to the place where our *Body* just before inclin'd upon its fall, and by this means we give a stop to the force of the fall, and sustain our selves the better, in regard the *Arm*, thus lifted up, keeps off its whole weight from the middle of the *Body* where the center is; and by this enlightenment gains sufficient force to counterpoise the rest of the *Body* which inclined on the other side; as we see that in a *Ballance*, a small weight hung at a distance from the Center thereof, holds an *equilibrium* against another far greater which is nearer the Center.

And this we learn'd when we were but *Infants*, that weights far distant from the Center, have always so much the more force, and that the *Arm* lifted up hath the more power to sustain the weight of the *Body* when it begins to fall, and that the Center of gravity must be always under our *Feet*. But tho' we practise all these *Rules* with the same

LXIX.
If all the
motions of
the Body
depended
upon our
Will, there
would be
no Para-
lyticks.

LXX.
There are
also certain
spontaneous
Motions
without De-
sign or Will.

LXXI.
Of motions
made to
hinder us
from fall-
ing.

LXXII.
That moti-
ons proceed
not from
any Cogni-
tion or
Knowledge.

ex-

exactness as the most able *Philosophers*, all the reflexions we make upon the Laws of *Motion* and of *Equilibrium* are useless and unprofitable in the *Practick*, and so far are these *Sciences* from being able to serve us upon any occasion, that they would be rather very prejudicial, were we minded to make use of them; since certain it is, that we perform better all these *motions* when we think not on them, than when we are intent upon them. We must therefore of necessity acknowledge, that whatever is acted in us, is without our *knowledge*; at least that *knowledge* we have sometimes by *reflexion*, is not at all the cause, since these *motions* prevent us in our *thoughts*; and these *thoughts* employed about them, rather hinder than help us. If then these *motions* so regular, so proportioned to their *performances*, so conformable to the *Laws* and *Rules* of the most refined *Philosophy*, can be performed so effectually and to the purpose in Man without any *Cognition* or *Knowledge*, how comes it that *Brutes* act by *Knowledge*? And why should it not rather be generally allowed what we maintain, that they are able to act by the disposition of the *Machin* of the *Body* only, according as we act by the like disposition of ours?

LXXIII.
How improperly
some
Physicians
speak, who
attribute
certain Passions to Na-
ture.

How unaptly and improperly do some *Philosophers* and *Physicians* speak, tho' seeming to utter great things, when with a *Magisterial Countenance* they pronounce that *Nature* abhors a *Vacuum*, and shews an aversion to what is disagreeable to her; that a *Medicin* chooses what *Humours* to attract, and passes by and leaves untouched others; *Nature* disposes her self to a *Crisis*, as to a *Combat*; that the *indeavours* to subdue or throw off the *Hostile Matter* of the *Distemper*, that being vanquish'd, she is reduc'd as it were to *desperation*, and as it were throws away, or lays down her *Arms*. By which ways of speaking, they do but fly to a pretty handsome way of concealing their *ignorance*; and that they may not seem to be put to a nonplus, and have nothing to say, they attribute to *occult Effects*, some, tho' no less *Cause*. Because, since *Appetue*, *Election*, *Will*, *Hatred*, proceed from our *Mind*, and are no other than various *modes* of thinking; we could not but be conscious of them, if they were found in us. But since we neither have a *Will* or *Aversion* to any of those things aforesaid, to which these *motions* tend, nay, are ignorant after what manner they are effected; they must maintain that these sort of *motions* are not found in us, or if they are found, that they have the *Body* only, that is, the disposition of the *Organs*, and influx of *Animal Spirits* for a *Principle*. Which how absurd it is to assert, no Man in his *Senses* can be ignorant, who knows that the *Mind* is distinguish'd from the *Body*, and that the ways of each are different one from the other. Otherwise what have we to do but to agree with the most *Illustrious Verulam*. That to all *Bodies*, of whatsoever quality, destitute of *Sense*, there is inherent a certain faculty of perception, if it be true, that when *Body* is applied to *Body*, there may be apprehended in them something very *Analogous* and *Cognate* to *Election*, in admitting things agreeable, and excluding or rejecting things ungrateful. What should we do, but allow *Cognition* to *Plants*, if some of them contract a friendship with others, and cover some parts of the *Earth* to harbour in more than

others, and make choice to themselves of what *Aliment* is most agreeable to them? And if others on the contrary fly so much as the touch of Neighbouring *Plants*, are pleased with a *sandy* or a *plashy Soil*, one more than the other; and several of them have an abhorrence, some of *Cold*, some of over-much *Heat*? What should hinder us from believing that the *Stomach* is indued with *Understanding*, if it discerns what is hurtful, from what is wholesome, and hath an *Appetite* to things only agreeable to it, and having taken *Poison*, is provoked to *Vomit*? For these *actions* belong to the *Soul*, and that thing must needs be indued with *Cogitation*, which loves and makes choice, which hath an *aversion*, which hath an *abhorrence*, which is delighted with one thing more than another, and hath an *Appetite*: So that I can by no means agree with the most Famous *Harvey* in his Opinion, that all parts of the *Body*, which by their own *motion* strive against *provocation* and *injuries*, enjoy a certain *sense* by which they are impelled to *motion*, and consequently that the *motions* and *actions* which the *Physicians* call *Natural*, are not performed without *Sense*; and that there is a certain *Latent Sense*, by which they are excited, provoked and altered; for were it so, we must consequently acknowledge that the *palpitation* of the *Heart*, *trembling*, *fainting fits*, *swooning fits* and alterations of the *Pulse* in *Magnitude*, *Celerity*, *Order* or *Harmony* which proceed from *Morbifick Causes*, altering and hurting the *Sense*, are indued with *Sense*.

Nor am I more inclinable to the Opinion of the *Peripateticks*, who attribute *Sense* to *Brute Animals*, and are persuaded that they *See*, *Hear*, *Smell*, &c. in the same manner as we do; which certainly no Man will allow, who forms to himself a true *Idea* of *Sense*, and hath attain'd so much *Judgment* as to understand what is included in the *Notion* or *Conception* of it; forasmuch as *Sense* is not distinguish'd from *Cogitation*, and is applicable to a thing *Spiritual* only and *Incorporeal*, from which it cannot be separated. Hence *Hippocrates* in his *Sixth Aphorism*, and *Second Section*, *They, who being agrieved in any part of the Body, yet feel no pain, their Mind is certainly sick*. If therefore they are not sensible when the *Mind* is sick, so as not to be intent upon the *Organs* of the *Senses*, much less can any other *Creature* be sensible of those things which beat upon the *Sense* less violently, unless the *Mind* be present; as we also find by experience in our selves. For it very often happens, that we run over with our *Eyes* the *Letters* of any *Writing*, and that our *Ears* are smitten with the *sound* of *Words*, tho' we neither *understand* nor *perceive* either the one or the other, because our *Mind* is set upon certain things, each of which nevertheless afterwards returns, and is represented to our *Cogitation*: If therefore Men who are indued with *Mind*, when they attend not, but are employed elsewhere, are not sensible, much less can *Animals* be sensible, who are *Senseless* and destitute of *Mind*. So that *Plutarch* rightly concludes in his Book *De Sagacitate Animalium*, *Mentem tantum videre & intelligere*, &c. That the *Mind* only sees and understands, and that all things else are *surd* and *blind*, in regard the passion of the *Eyes* and *Ears*, when they are smitten by *Objects*, stir up no *Sense*, if the *Cogitation* of the *Mind* be absent.

Nor

LXXIV.
Nor less
improperly
they who
attribute
Sense to
Brutes.

LXXXV.
Aristotle's
Opinion,
that Mind
only is sen-
sible.

Nor do *Aristotle's* own words, *Section II. Problem 33.* make less for our business; for the *Philosopher* having made an inquiry, why *Night* is more accommodated for *hearing* than *Day*, after he had quoted *Anaxagoras* his Opinion, who judged the reason to be because the *Air* in the *Day* time, heated by the *Sun*, hisses and makes a Noise, but by *Night* is silent and at rest, the *beat* being then gone; goes on with his Discourse in these words, *Quoniam Corpora interdiu, &c.* because *Bodies* by *Day*, variously divide and disperse the force of *Understanding*, and put it upon divers operations, so that the *sense* of *hearing* plain is taken away; and by reason we act and manage all things more by *Day* than by *Night*, the *Intelligence* it self is hindered and interrupted by the affairs of the *Body*: But *Sense* when it is separated from *Intelligence*, is upon, as it were, an insensible work; whence that saying, *Mens videt, Mens audit*, the *Mind* sees, the *Mind* hears; that is, perceives *Objects* which finite the *Organs* of the *Body*, for no other things are thus perceived by the *Mind*; whence it follows necessarily, that those things which are void of *Mind*, are also destitute of *Sense*.

LXXXVI.
The Vulgar
Objection to
shew that
there is
Sense in
Animals.

But some will start up, and cry out against this Opinion as Cruel, and will call it the utter extirpation of *Animals*. What, will they say, will you deprive all *Animals*, not only of *Intelligence*, but also of all *Sense*? O Barbarity! What can be more oppugnant to Experience, and the common Opinion of all Men? Do we not daily behold *Beasts* coming nearer and nearer to perfection, looking seriously upon visible *Objects*, and receiving sounds in at their *Ears*, by which sounds they are excited to *Labour*, to the running of *Races*, to *Meat*, to *Drink*, and other such like actions? who knows not that a *Cat*, *Dog* or *Ape* distinguish their *Food* by *smelling*, and hunt after that which is agreeable and grateful, and fly and eschew that which is ungrateful and noxious? How can it be that a *Spider*, sitting in the midst of his *Web*, can feel when a *Fly* is intangled in the remotest part, and yet be destitute of the *Sense* of *Touching*?

LXXXVI.
Sense is to
be distinguished
by three de-
grees.

Our business therefore is to shew, for what reason we exclude *Sense* from *Beasts*; and how it comes to pass, that they have *Eyes*, yet see not; are provided with *Ears*, yet perceive no sounds; are not without a *Nose*, yet smell not; have the use of a *Tongue*, yet discern nothing by any different relish or *Savour*; which the better to effect, we propose a thing Note-worthy; that our *Sense* is to be distinguish'd into three degrees. The first degree contains that simple motion which the *Object* impresses upon the *Nerves*, or that whereby the *Organ* of the *Body* is immediately affected by external *Objects*, which can be nothing else but the agitation of the particles of the said *Organ*, the change of *Figure* and situation proceeding from this agitation: For *Sense* consists in *Motion*, and as *Aristotle* asserts in his Third Book, *De Animalibus*, Chap. 13. no motion can be had without contact. So that a *Corporeal Organ* must needs be touch'd after a *Corporeal* manner, and motion must needs be impress'd upon sensible things. When, I say, that the motion of an *Object* is impress'd upon a *Corporeal Organ*, I would not have it understood that the motion, for example, of the *Eye*, is only made there, but that it passes up to the *Brain*, from whence the *Fibres* of the *Nerves*,

like *Lutestrings* in a *Lute*, are stretch'd out to other Members. The Second Degree contains Perception, which is tied to that motion, whenever this impression is carried to the *Pineal Glandule*, or seat of the *Soul*. Such are the perceptions of *Pain*, *Tirillation*, *Thirst*, *Hunger*, *Heat*, *Sound*, *Savour*, and the like; which, we say, arise from the substantial Union of the *Soul* with the *Body*. The Third contains all those judgments which attend those Perceptions, that is to say, those judgments which, from the very first we have ever used to make of things without us upon occasion of the motions of a *Corporeal Organ*. Or to comprehend these three Degrees of *Sense* in fewer words. The first Degree is the affection or motion of a *Corporeal Organ*: The second the perception of that impression which is proper to a *Corporeal Organ*: The third the determination of judgment to affirm, or deny any thing. And still to render the matter a little more plain, when any one beholds, for example, the *Moon*, the *Corporeal Organ*, that is to say, the *Eye* is moved, or affected by the *Light* which is reflected by the *Lunar Body*; and herein consists the first Degree: The *Mind* presently perceives the *Light* or *Colour*, and this is the effect of the second Degree. Moreover the *Mind* assigns *Colour* to the *Moon*, that is, delivers its judgment, as asserting that the *Moon* is coloured, and this is the result of the third Degree.

These things thus premised, it manifestly follows, that *Animals* are void of *Sense*, properly so call'd, unless we admit for *Sense*, that *Corporeal Motion* which preceeds Perception, and hath reference to it, as to something begun and imperfect. For it is of *Corporeal Motion* only that *Animals* are capable; nor do we deprehend any thing to be in them, which can persuade us that they are sensible, if the word *Sense* be taken for any other than the impression of the external *Object* upon the *Organ* of the *Senses*: So that those persons that think the motion of a *Corporeal Organ* deserves the name of *Sense*, are no less absurdly persuaded, than they who maintain that the *Optick Cubicle* sees while it receives the *Species* of external *Objects*, and represents things done without. That the *Eye* of a slain *Ox* sees wherein all things are distinctly delineated, no less in than the *Retin* or *Network Tunicle* of a surviving *Ox*. That *Men* see, who, like *Hares* sleep with their *Eyes* open; and cannot be discern'd to be awake, any otherwise than by the loosning of their *Eyelids*. When as the *Optick Chamber*, the *Eye* of the dead *Ox*, the *Retin Tunicle* of a sleeping *Person*, receive the *Species* of external things; and in the same manner as they represent the *Picture* of *Objects*: So that if *Corporeal Motion* be allowed to enjoy the name of *Sense*; by the same force of Reason it may be infer'd, that it may be attributed to *Inanimate Things*.

But I can easily imagin what may be objected against this *Ratiocination*; namely, that a *Body* is the Instrument of *Sense*, whose action must needs intervene to our *Sensations*, and consequently that for producing of *Sense*, there is required an *Organ* disposed after a certain manner; that is to say, into which the *Animal Spirits* may flow, and whose motion may reach up to the *Brain*, which without motion cannot be done. All these Conditions I willingly grant, and I confess it is requisite for the making of us sensible, that an *Organ* be

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LXXXVIII.
How Sense
may be ap-
plied to
Brutes.

LXXXIX.
Sense con-
sists not in
the motion
of a Cor-
poreal Organ,
but in Per-
ception.

modified by certain *dispositions*; but I only insist, that neither the *action* of an *external Object*, by which the *Organ* is moved and disposed; nor the *mutation* of *Figure* and *Situation*, which promotes that *Action*; nor that *transmission* which is made to the *Brain*, are *Senses* or *Apprehensions*; but that which immediately results in the *Mind*, which is joined to the *Corporeal Organ*, so disposed: For how can that saying of the Prophet *Isaiab* be understood, *In bearing ye shall hear, and shall not understand; and seeing ye shall see, and shall not discern*: Unless the first degree be supposed to be distinguished from the Second, and that *Corporeal Motion* may be disjoined from *Perception*, or attention of *Mind*.

LXXX.
Corporeal
Motion may
be had
without
Sense.

But what need is there to have recourse to *Holy Scripture*, to prove *Perception* to belong to the essence of *Sense*; and that the *work* of the *Mind* is required to be concerned, when we are said to *hear, see, smell, &c.* since we find it not seldom by experience in us, as namely when the *Mind* being very much taken up in *contemplating* other things, a *Man* may pass by us, and not be taken notice of, tho' our *Eyes* be open, and directed towards him, there being no obstacle in the way to hinder; and so likewise not observe his *Speech*, tho' our *Ears* be open, and immediately take in *sound*; We may also not *taste* the relish of *Meat*, tho' the *Fibres* of the *Tongue* be smitten by the *Corpuscles* of the *Meat*; and the whole plexure of the *Organ* be never so clean, and void of all clog or impediment: Lastly, we may be exempted from the *pain* of *Cold*, tho' in a rigid *Climat*, and the *Air* ready to freeze, through the bitterness of the *weather*. All which things sufficiently prove, that not the *Members* or *Organs*, but the *Mind* only do *see, hear, taste* and *feel*.

LXXXI.
How those
are mis-
taken, who
from exter-
nal actions
judge
Brutes to be
sensible as
we are.

Whence it is apparent how foolishly those persons reason, who because they observe *Brute Animals* to be mov'd by the *Species* of *external things*, and to feed as *Men* do on *Meats* offer'd them, to be affected with *sounds*, to be taken with the aspect of some *Objects*, and frightened with that of others, presently infer that *Beasts* also are sensible; that is, that they think and give attention to any thing that is offered; whereas indeed all those *motions* in *Animals* are performed without any concurrence of the *Soul*, and only effected by a blind impulse of *Organs* and *Animal Spirits*. This error hath grown up with us from our *Infancy*, as *Claubergerius* observes in his *Prolegomena Logica*, by reason that at that time, and in that very moment, in which our *Corporeal Organs* were moved by *external things*, the *Mind* joined to the *Body* had still a perception of some thing, and so we taking both for one, attribute perception to the *Corporeal Organs* of the *Senses*; which the *Wise* attribute only to the *Intellect* or *Understanding*. Hence we say generally by way of familiar speech, that the *Eye sees*, that the *Ear hears*, that the *Tongue tastes*, that the *Nose smells*, that the *Hand feels*; nay, which is more, because whilst the *Body* was affected with *external things*, the *Mind* also perceived something, and thereupon presently made a judgment of something; hence we ascribe estimation and judgment to *Corporeal Organs*, to which nevertheless the *Philosopher* knew well enough that *Body* is not desired, but that besides the apprehension of the *Intellect*, the assent of the

Will is also required. For just as it often happens in other things, so doth it also in these *Acts* of *Understanding*, *Imagination*, *Perception* and *Judgment*, namely that they are often taken one for the other, and confounded together, and only for this reason, because they exist together at the same time. So because whilst the *Eye* is moved by the *Light*, the *Mind* also joined to the *Body* perceives something, and at the same time judges; therefore these three different things, viz. the motion of the *Body*, the perception of the *Mind*, and the judgment, are all taken by the *Vulgar* for one and the same thing, and are all express'd by that one term of *Seeing*, as when they say *I see the Sun*. But the *Wise* are far above this manner of *speaking*, as well knowing the difference between that which, in our *sensations* belongs to *Body*, and that which belongs to *Mind*; for the motion which an *external Object* impresseth, and the mutation of *Organ* belongs indeed to *Body*; but it comprehends no *Perception* or *Cogitation* which is proper to the *Mind*, and from which it cannot be separated.

This Opinion *Divine Plato* maintains in *Marsilius Ficinus*, in his *Argument* against *Thetatus*: We must note, saith *FICINUS*, that *Plato* allows no *Cognition* to *Body*, as likewise no *Life*: That which lives, is sensible; the *Soul* lives, and the *Soul* is sensible; but in the *Body* there is neither *Life* nor *Sense*; yet the works of *Life* and *Sense* are visible in it. So that those which some call the *Five Senses*, he will have to be called the *Five Organs* of *Sense*, and asserts that nothing hath any sensibility by these *Instruments*, but that through these, as it were, passages, each part of *Sense* is performed by one certain force of the *Soul*, which operation he calls the *Common Sense*; into which various passions have influx as *Lines* from the circumference to the Centre of a Circle. Colours, through the *Eyes*; Sounds, through the *Ears*; Odours, through the *Nose*; Savours, through the *Tongue*: Lastly, heat, cold, moist, dry, grave, light, soft, hard, smooth, rough, rare, dense, acute and obtuse, through the whole *Body*. That this *Soul* is sensible, not by many, but by one power, is apparent, since when we feel heat, we do not give this *Sense* the appellation of *Voice*; nor when we perceive any thing of a *Savour*, do we call it *Odour*. He cannot distinguish one thing from another, who knows not both. No one *Organ* performs the same things as another doth; or if the same things, not in the same manner; so that the distinction of those things which are perceived is not in the *Organs*, but in one certain power of the *Soul*, perceiving each thing, and distinguishing all things one from another. All which, since the *Soul* alone is able to effect, as the *Peripateticks* themselves cannot deny, what need is there of many *Senses*.

From which words of *Plato*, we may thus argue: If *Sense* resided in a *Corporeal Organ*, it might be said the *Eye sees*, or the *Ear hears*; but according to *Plato's* Opinion, neither the *Ear hears*, nor the *Eye sees*; nay in the *Body*, there is neither *Life* nor *Sense*; only by it the works of *Life* and *Sense* are made to appear: And it is the *Soul* as *Marsilius* saith in another place, which is in pain or rejoiceth, not the bulk of the *Body*; consequently there is no *Sense* in a *Corporeal Organ*.

From

LXXXII.
According
to Plato
there is no
Sense but
from the
Soul.

LXXXIII.
Corporeal
Organs
perceive
nothing.

From hence also it is clearly to be deduc'd, that *Brutes*, since they are void of *Mind*, and have nothing but *Corporeal Motion*, do not, for example, see like us, that is, as being sensible, or taking notice that they see, but only as we do when our *Mind* is elsewhere employ'd, or called aside, tho' the *Images* of external *Objects* are painted in our *Retin Tunicle*, and perhaps also their impressions being made in the *Optick Nerves*, dispose our *Members* to different *motions*; yet nevertheless we perceive nothing of them: In which case it appears also, that we are moved no otherwise than as *Automata*, as hath been already declared by several Examples.

LXXXIV.
For what
reason Ani-
mals are
said to
have five
Senses.

Wherefore if all the *Freaks* of the *Brain*, and all the *motions* of the *Animal Spirits*, which are caused by the *Nerves*, must needs be called *Senses*; it may be said that *Animals* have five exterior *Senses*, because there are five sorts of *Nerves* which convey the impressions of *Objects* to the *Brain*, and which dispose the *Animal Spirits* to insinuate divers ways into the *Muscles*, for the moving of the *Members*: Hence it is, for example, that *Animals* are said to see, when the *Light* enlightens the *Optick Nerves*, and by them the parts of the *Brain*, from whence they have their *Original*; that they hear when the *Air* which hath been smitten by any resounding *Body*, strikes upon the *Nerves*, which terminate in the *Ears*: That they taste when the particles of the *Viands* which they chewed, have force enough to enter the pores of the *Tongue*, and so excite the *Nerves*: That they smell when the most subtile parts of the *Body* which they environ, being mingled with the *Air*, which causes *Respiration*, hit against the *Nerves* that terminate in the *Nose*; and that there is simply a *Sense* of *Feeling*, when any exterior object is immediately applied to some part of their *Body*, and have force enough to agitate the *Nerves* which there terminate. It is said likewise that they have *Sense* of *Pain* when the agitation of the *Nerves* is very violent, and that they have relaxation of *Pain*, when this agitation is indifferent; but all these *sentiments* are nothing else but the power which the *Animal Spirits* have to be disposed by the presence of *Objects*, to pass through the *Brain*, and through the *Nerves* into some certain *Muscles* rather than others; and by consequence that there are no *Senses* but according to the first degree, that is to say, that they have none but *Corporeal Motions*.

LXXXV.
Dr. Willis
his Opinion
about the
Cognition
of Brutes.

The Famous Dr. WILLIS in his *Exercitation* concerning the *Soul* of *Brutes*, where he acknowledges a *Corporeal Soul* in *Brute Animals*, and fancies it to be of an *igneous* or *fiery Nature*, and of kin to *flame*, thinks it no absurd thing that there should be allowed in *Animals*, a power to speculate and discern the *Images* of sensible things delineated in the *Brain*, and to draw forth, according to the impressions there conceived, *Appetites* and respective *Acts* of other *Faculties*. In regard tho' the *Soul* and *Body*, taken apart may not have the same power; yet this hinders not, but that from a certain Law of the *Creation*, as he calls it, or Institution of *Almighty GOD*, an *animated Body* may be so disposed, that from *Soul* and *Body* joined together, there may result a *confluence* of such sort of *faculties*, as shall be needful for every *Animal*, for the ends and uses designed it. In

many things framed by *Human Art*, the *Workmanship* hath exceeded the *Materials*, as who would think that of *Iron* and *Brass*, the most fixt and unactive of *Metals*, an *Instrument* should be composed, whose *Orbs* imitating the *Celestial Orbs*, should observe *motions* little differing from perpetual, whose *periods* renewed by a constant vicissitude should most certainly measure the spaces of *Times*? No wonder that from a *Wind* blown into a *Pipe*, a rude and simple *Sound* should be produc'd, but that from a *Breath* infused into *Musical Organs*, and so variously transmitted through manifold apertures of *Valves*, or stops into such and such *Pipes*, a most grateful harmony should arise; this, I say, we cannot but admire, and confess withall, that this effect far exceeds, as well the matter of the *Instrument*, as the *Hand* of the *Musitian* playing, tho' the *Musical Organ* require for the most part the skill of the said *Artist*, by whose direction the *Breath* admitted, now into some, now into other *Pipes*, performs manifold *Harmonies*, and almost an infinite variety of *Moods*. So in some *Brutes* of the more perfect kind, whose *Actions* are ordained for many and more noble uses, there ought to be attributed a certain faculty, that is, the *Brutal Soul* it self, naturally so endow'd, as to be rendred knowing and active about some things necessary for it, by various accidents with which it uses daily to be affected, and afterwards is taught to know other things, and to exert far more, and more difficult *Actions*.

This similitude I easily admit, as from which much *Light* is added to the forsaide *Reasons*, demonstrating, that *Brutes* are meerly *Machins*, which act according to the *Laws* ordained by the *Creator*, and after the manner of a *Musical Instrument*, which by a *touch* or *breath* infused, produces most admirable *Harmony*: Forasmuch as by the circuit of the *Blood* through the whole *Body*, they effect all their *motions*. But still I am not able to comprehend how from the union of two material, and consequently insensible *substances*, *sense* and *perception* should arise: For however in *Machins* the *Matter* is exceeded by *Art*, and from the mixture of divers *Metals Instruments* are framed for wonderful performances, yet this argues not that *Matter* can ever be brought to that perfection, as to be apprehensive of things that occur to them, and to be sensible that they apprehend them. But suppose that by a certain Law of the *Creator*, there may be attributed to a *Body* instructed with *Organs*, and designed for certain uses, some power of sensibility, which cannot belong to *Body*, nor *Soul* taken apart, but only to a compound resulting from both. Yet by the leave of this most Learned Man, I would gladly know what that Principle of Sensibility is, whether some substantial *Mode*, by which a *thing Animate* is differenc'd from a *thing Inanimate* and insensible, by the access whereof an *Animal* is constituted? But nothing is found in an *Animal*, which can distinguish it from things *Inanimate*, excepting the *Blood*, which by an incessant Motion, is impelled into the *Veins* and *Arteries*, to nourish the parts of the *Body*. Now what activity is there in the *Blood* that it should impart sensibility to the *Body*? Is there haply a certain *Universal Soul* coævous to *Matter*, which actuates it, and brings it to perfection, according to its various

LXXXV.
Dr. Willis
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disput.

dispo-

dispositions? This being granted, who will not see a necessity, that then not only *Animals*, but *Plants* also and *Stones* must have *Sense*: Forasmuch as that active and Energetick Power, by the same right may as well be infused into them by the great Founder of *Nature*; or is it some Principle Emerging from *Soul* and *Body* joined; by which an *Animal* is rendered capable of knowing the impressions of *Objects*? Surely whatever this Principle may be fancied to be, since it must need be *Material* and *Extense*, it cannot be indued with the power of *Acting*, *Thinking*, *Perceiving* and giving *Intention*. For it is not to be understood, how from *insensible things*, another *thing* should arise which is *sensible*, and *perceptive*? By what means a *corporeal thing* should produce *spiritual Acts*; and that which is *extense*, should bring forth that which is void of all *extension*?

LXXXVII. But if this most famous *Author*, while he allows a Principle of *Cognition* to *Brute Animals*, means that their *Cognition* is nothing else but the reception of a *material Species*, or a various motion of some interior part of the *Brain*, we give our *Hand* and subscribe to his Judgment; since we acknowledge and confess, that these sorts of different motions in *Brutes* are affected by various impressions of *Objects*. But we can by no means be induc'd to grant, that the *Idea* of *Local Motion* agrees with the *Idea* of *Cognition*, or that the *Perception* and the *Motion* of a *Corporeal Organ* are not distinguish'd from each other, in regard since *Body* and *Mind* are totally different in their kind, and the distinction which is between the *mode* of one *Substance*, and the *mode* of another *Substance*, is real; it must needs be that the difference between *Perception* and the *Motion* of a *Corporeal Organ* is equal, and consequently that they cannot both proceed from the same Principle.

LXXXVIII. Haply, for this cause some of the more Modern *Philosophers* deny rationality and discourse to *Brutes*, as being inconsistent with *Material Organs*, since they judge *Beasts* incapable of beholding any thing with reflection; yet cannot persuade themselves, that they do not perceive, so long as they behold *Objects*. What, say they, shall they behold *Objects* with their *Eyes*, receive *Sounds* into their *Ears*, and yet not conceive these different *Species* or *Images* painted in some part of the *Brain*? What should hinder, but that as there is allowed a double *Memory*, one *Sensitive* the other *Intellectual*; so in like manner, there may be suppos'd one *Sensitive Perception*, another *Intellectual*? To this, besides what hath been already urged in some former parts of this *Discourse*, there needs no other answer, but to affirm, that by admitting such a *Perception* in *Brutes*, they grant them a degree of *Perfection* equal to that of *Men*, if not greater: For wherein do they imagine *Sense* to be distinguish'd from *Reason*? Doubtless herein the *Cognition* is apprehensive of *Sense*, and *simple*, therefore not obnoxious to falsity: whereas the *Cognition* of *Reason* is a little more *Composite*; and it may be made out by the conclusions of *Syllogisms*, that it seems no way to argue a greater perfection, especially since they affirm the *Cognitions* of *GOD* and of *Angels* to be most simple, and only intuitive or apprehensive, and perplex'd by no intricacies of *Discourses*; so that by them, if we may so say, the *Sense* of

Animals comes nearer to the *Cognition* of *GOD*, and of *Angels*, than Human Reason.

As to the *Sensitive Memory*, or memory of *material things*, we easily allow it to *Beasts*, since it is fixt to a *Corporeal Organ*, and depends upon the *Vestigia* or footsteps remaining in the *Brain* after some *Image* had been impress'd upon it; forasmuch as those *Vestigia* are no other, as I have at large made out in my *Institution of Philosophy*, than certain *Paths*, which the course of the *Animal Spirits* hath left among the *Fibres* of the *Brain*, through which at first they pass'd, in the same manner as *folds* in *Paper* or *Linnen* render the said *Paper* or *Linnen* the more apt to readmit the same *folds* as before, I say more apt than if no *folds* had been made there; whereby it comes to pass, that the *Fibres* of the *Brain* are indued with a *Power* of attracting and disposing the *Spirits*; so that the next time they may have egress through the same *Vestigia*, in the same manner as they had egress the first time. So that this sort of *sensitive memory*, consists in the disposition of the parts of the *Brain*, induc'd from the *Objects* through the *Senses*. Which disposition, if it happen to be inverted, or destroy'd, the *Memory* immediately must of necessity be either weakened or utterly perish: As may be proved by many examples in those, who either by the blow of a *Stone*, or by the sharpness of some *Distemper*, or by a fall from a high place, have lost the use of their *Memory*, forgetting all those things which they knew before. See the *Natural History*, the last Part. Nay some there are who have had the *Vestigia* of their *Brain* so far disturb'd by the overmuch taking of *Tobacco*, as to abolish all signs of things, and to overthrow the *Characters* long since there impress'd. Whence it is plain that the *Memory* is a *Corporeal Faculty*, which by the *Vestigia* which it confers from the *Species* of *Objects*, hath a power of exciting those *Images* anew, and of procreating the *Idea's* of things formerly done.

Nothing therefore hinders, but that *Animals* may remember,

And mindful Goats unto their Huts return.

(as *Virgil* hath it in his *Georgicks*) while the *Images* of *Corporeal Objects* recur in the same order as they entred the *Loculi* or *Cells* of the *Brain*, and stir up the same kind of motion in their *Nerves*. Yet all this while they do not perceive that they remember, nor do they, neglecting other things, make any choice of what they chiefly have need of, nor search after new things, nor call to mind former configurations, but act after the manner of *Minstrels*, who play upon the *Harp*, touch the *Chords*, and produce various sorts of *Harmony*, without any care or heed to what they are about. So the *Dog Argus* knew, and fawned upon *Ulysses* after his twenty years travel. So the *Birds* flying out of their *Nests* for food into the *Woods*, return from a far off: So *Fishes* upon signs given, run to the *Meat* thrown them in their *Ponds* and *Lakes*, and afterwards retire to their *holes*: So the *Wild Beasts* return each to their *Dens*, tho' far apart, and by their *Scent* find out their way when-ever they chance to lose it. Because the *Animal Spirits*, finding the *pores* of the *Brain* through which they for-

LXXXIX.
There is a
Sensitive
Memory to
be found in
Beasts.

XC.
Divers
Brutes are
void of the
Intellective
Memory.

formerly began their course, enter them more easily than others, by which means they excite a special motion in the *Glandula Pinealis*, whereby the same Object is again represented to them; haply for want

of these *Vestigia*, the *Tucani* are indued with little or no *memory*, in so much that going out of their *Den*, they know not the way in again, but are forc'd to dig another to repose in.

The Second Part.

A

DISSERTATION

Of the want of

S E N S E

A N D

K N O W L E D G E

I N

BRUTES.

I.
The order
of things to
be declared
in the Se-
cond part of
this Differ-
tation.

ALTHO' it hath been made out by Reasons strong enough, that *Brute Animals* are destitute of *Sense* and *Perception*, and that nothing of *Cognition* is to be discern'd in their Operations, and consequent-ly, that a well-contriv'd Structure of the *Members*, and a precise direction of *Animal Spirits* through certain *Passages*, must needs be the Principle of all their *Actions*; yet in all this we cannot pretend to have done any thing to the purpose, unless we descend to particulars, and make it appear, that all the *Actions* of *Animals* may be mechanically demonstrated, and that the motions which we think proceed from a certain *Soul* in *Beasts*, are of kin to those which are produc'd in *Automata*, by virtue of a Spring, and disposition of *Wheels*. It is indeed a difficult Labour, yet nevertheless necessary to be undertaken, if we intend to bring the Work begun to its desired end, and make a solid superstructure to the foundations we have laid: But the better to observe a certain Order and Method in this Second Part of this Dissertation; we judge it expedient to reduce all the Operations of *Brutes* into Five Classes or Ranks. The First of them is those which are inbred in *Beasts*, to the exercise whereof they are carried by a certain innate force. The Second is of some *Actions*, which argue a sort of Craft in them, and bear some signs or semblance of *Intellect*, *Judgment* and *Discourse*. The Third is of those which insinuate the docility of *Animals*, and their apti-

tude to be instructed; implying that something of Reason shines in them as well as in us. The Fourth is of *Actions*, which discover a kind of *Mutual Speech* in *Animals*, and which seem to make a kind of necessity of allowing the use of *Language* common with us. The Fifth and Last is of some *Actions*, by which *Animals* seem to excel the cunning and sagacity of *Men*, and that there is peculiar to them a Providence, and Foreknowledge of things to come, above what falls to *Mans* share and lot to be indued with.

As to the First it is evident, that there are *Actions* proper to every *Species* of *Beasts*, and that they are so determined to certain Operations; that they all design and perform the same thing without any difference. *CAMELS* fly from pure Streams, and hunt after muddy and troubled Waters; in so much that when ever they go into a *River* to drink, if the *Water* be not muddy, they raise the Mud by a vehement scraping on the Ground with their *Feet*. *CONIES* continually dig themselves *Burrows* to lodge, and cover them with Sand, that they may not lie open, and be exposed to the rapines of the *Ferrets*. *HARTS* shot in their Side with a Dart, presently seek after the Herb *Dittany* for the curing of their Wound, and expelling the Pain with which they are afflicted. If the Root of *Valerian* be thrown before *CATS*, they run to catch it, they lick it, make much of it, and like Persons Dancing and Skipping, they run about and discover many signs of Joy and Pleasure. A *HEN* at the

II.
Some Operations of
Beasts produced by
Natural Instinct.

S C

fight

III.
The same
Nature is
in all Ani-
mals of the
same Species

fight of a *Kite* makes a *clocking*, and as it were exhorting her *Chickens* to flight, she still advances her *Voice*, and calls them under her *Wings*.

The cause of all these *Actions* can be referred to nothing else but *Natural Inclination* and *Instinct*, by which *Animals* are instigated to such and such *motions*, and resolve upon what things are convenient for them: So that this, or that whole *Brutal Species* is carried with one propension, and there is the same force, and the same impulse found in all of that Kind. So every *HARE* is a like fearful, and by the method of subtilty declines all Dangers and Inconveniences of *Life*. Every *HOUND* hath a kind of Craft and Innate Industry in following after *Wild Beasts*. All *FOXES* are shrewdly cunning, and generally use the same sort of *Art* and *Method* in *laying Snares* for *Birds*. Every *APE* expresses human gestures, and with one and the same sort of imitation receives whatsoever is offered or comes in its way; whence it is evident that nothing of Reason is concern'd in any of these actions, but that *Brutes* are impelled to them by a certain necessity, and according to that familiar saying in *Schools*, they rather *suffer* than *act*. For how can a *CAMEL* know that a draught of *Water*, the purer it is, the more it causes the *Gripes* of the *Belly* in him; or that in regard of the simplicity of its *Substance*, it affords him the less *nourishment*? How knows a *CONY* that the *Ferrets* lay ambuscadoes for them, and that if they did not cover their *Hole* to keep them out, they should be expelled themselves by the *injury* of their *Teeth* and *Feet*, and whatever hostility besides? How should a *HART* know that the *Herb Dittany* is available for the drawing out of a *Dart* shot into his *Side*? A *HEN*, that a *Kite* lays wait for her *Chickens* to snatch them away and devour them? Certainly if they did, *Beasts* would be wiser than *Men*, as having the faculty to explore and find out things before they came to make trial, or have experience of them; and being able to understand occurrences, before they could arrive at the *Organs* of their *Senses*. For *BEEES*, we see, scarcely brought forth into the *Light*, begin to build *Hony-Combs*, gather *Hony*, attend their *King*, and perform all the *Offices* of their little *Commonwealth*. Young *ANTS* testify no less providence than those of more age. *CHICKENS* newly hatch'd out of the *Shell*, dread and avoid the *Kite*. The *Kite* by no other *Instructor* but natural *Instinct*, lays wait for the *Hen*. The *WOLF* from his very *Cradle*, if we may so say, with an innate hostility prosecutes the *Sheep*. The *SWALLOW* builds and covers its *Neast*: The *SPIDER* its *Web*, without any other Teacher but natural *Instinct*. By which it is plain, that *Animals* are not directed by Reason, but by the Conduct of Nature only, which is alike prevalent in all.

IV.
That Beasts
of every
Kind can
not but do
actions
which are
proper to
them.

And for the better conceiving that *Beasts* of every Kind ought to perform *Actions* which are proper to them, we need but consider, that they act no otherwise but by the force of their *Mechanism* or *Structure*, and by the disposition of their *Organs*: For as we ought to believe, that they are destin'd to different uses, according to the diversity of their *Species*, so we need not doubt on the other side, but that the Author of Nature

hath furnish'd every one of them with *Organs* proper for the performance of those *functions* which are most agreeable to their *Nature*; as for example, there are in *Ants*, motions very regular and very necessary to lead them in *Summer* time, to those *Objects* which they have need to make provision of against the *Winter*. *Swallows* build their *Neasts* with more artifice than the skillfullest of *Men* can do: And a *Dog* in finding out his *Master* shews more sagacity than in matters of that nature is usually discerned in *Man*.

Moreover there occur to us some *Works* of *Nature*, which seem not possible to be performed without *Sense* and *Reason*, as hath been observed in the beginning of this *Discourse*: For how comes it to pass that *Spiders* weave their *Webs* so *Geometrically*, and *Bees* compose their *Cells* so neatly and orderly, each being appointed their several *Offices*; some to lay up the *Hony*, others to exclude the *Drones*? To which end they make some of their *Cells* oblong, the better to receive the forms of their *Bodies*; and on the other side make them open to leave egress and regress, yet at the same time it is so ordered, that not above two rows of *Cells* can be opposite one to the other, namely, one at the top, and the other at the occluded part. Besides, when in framing the *Walls* of their *Cells*, there is a necessity that the *Wax* be separated, and carried out from all parts: How do the *Bees* so contrive it, that every *Bee* taking its round with compressed *Wings*, six other *Cells* should be drawn circularly near the *Wax-Cell* towards the sides, and as many towards the top, and all for the convenience of the circular *Figure*; which is so ordered as to be touch'd by six other equal and conformable *Cells*: Furthermore, there must be a *Hexagon* or *Sixangled*, and a *Hexaedric* or six-sided *Figure*, conformable as well at the *Sides* as at the *Top*, in such manner, as while six *Circles* are contiguous about a seventh, and make a compression, this compression is to be mutual so far as till it falls into six *Sides*, equal to a *Semidiameter*, and common as well to the containing as the contained *Circles*.

But these and the like Operations are not to be attributed properly to *Cognition* or *Cogitation*, but to some other *intelligence*, which *Averroes* calls *Non Errant*: So as that the *Corporeal Nature* must follow the conduct of *Divine Reason*; and its *Works* be look'd upon as *Darts* or *Arrows* which are directed by a skillful *Marksmen*, to the Aim or Mark which the *Darts* or *Arrows* themselves have no suspicion or apprehension of. So that this *Natural Force* infused into every *Animal*, is the *Original*, and as it were the *Source* of all those *Motions* and admirable *Effects*, which do not only exceed all our *Efforts*, but which we can hardly attain to by our greatest application of *Wit* and *Ingenuity*: Whence the Great *DESCARTES* in his 45th *Epistle* to a certain Nobleman, I am not ignorant (saith he) that many things are performed by *Brutes*, far better than by us; but this I do not in the least wonder at, since it helps to prove that they perform them *Naturally* and as it were by *Springs*; no otherwise than a *Clock* or *Dial*, which declares the *Hours* far better than we can find it out by our exactest Judgment: And doubtless when the *Swallows* approach in *Spring* time, they all therein in the manner

V.
After that
manner
Bees make
their Cells
so ingent-
ious.

VI.
The whole
operation of
Bees pro-
ceeds not
from Rea-
son, but in-
stinct of
Nature.

manner of Clocks or Dials: And whatsoever Bees perform, is of the same nature, as is also the Order which Cranes observe in flying, Apes in fighting; if at least they observe any. Lastly, the instinct by which they are carried to bury their Dead, hath nothing more to be wondered at, than the instinct of Dogs and Cats, who, going about to cover their Excrements, scrape up the Earth in order thereunto, tho' perhaps they never proceed so far as to cover them; which shews that they act unthinking, and only by instinct. But if after all this any one still remains obstinate, and will have it that Intellect and Reason must be allowed in Beasts to produce all those wonderful Operations; what hinders but that whatsoever things in Nature give occasion of admiration, may be said to proceed from Reason? Why may we not by the same reason maintain, that a Clock or Dial is indued with Intellect, as long as the Index, turning about by a Spring of Motion infixt, sometimes by a deflux of Water, sometimes by the stress of a Weight hung on, sometimes turned about by the reflex of an intorted Steel, designs the Hours? Why may not the Needle be said to be prompted by Reason to fly to the adjacent Loadstone, for the obtaining of its embraces? The Bees therefore erect their Habitations, as HARVEY admirably expresseth it, by a Natural impulse, and as it were by a fatal necessity, or a certain mandate, working according to the Law of the Creator, but act nothing by Providence, Design or Council. For what in us is the Principle of Artificial Operations, and is called Art, Intellect or Providence; that in these Natural Works is meer Nature, depending upon no Mans Instruction.

VII.
Whence
arise the
diversity of
Actions in
Brutes.

But if it be required, how it comes to pass that so great a diversity of actions should be produced among Beasts? How each Animal should have its proper Machination, if they operate according to inbred impressions, and are impelled as it were by a certain weight? I answer, that this happens from the various disposition of the Brain, and the Organ, which according as it varies in Animals of a different Species, so it brings to pass, that an affection of the same Object is directed to different Motions: Forasmuch as nothing else can be understood by the name of Natural Instinct, than the Local Motion as of the whole, so of the minute parts indued with a certain magnitude and Figure, according to which natural things are distinguished, and obtain various denominations. Now those motions which follow corporeal dispositions, may be reduc'd to three Heads. The First is of those, by which Animals, through a certain inbred impulse, hate and decline those things which are hurtful and troublesome to them; as a Sheep abhors the sight of the Wolf, and immediately upon the said sight thereof, betakes it self to flight with all imaginable haste: Almost all sorts of Animals dread the Lion, and are terrified at the sight of him: On the other side, the Lion fears the Cock, and trembles both at the hearing of his Crowing, and sight of his Crest: So the Chickens fear and fly the Kite, &c. The Second is of those by which Beasts apply themselves to the propagation of their Kind, and the generating of their like; so the Silkworm weaves its Egg; so Fishes and other Animals, by a certain inbred propensity, do many things which tend to the foresaid end.

The Third is of those things by which Brutes provide for their own preservation, and sustain themselves from perishing, they go out to get their Food, they make choice of their Meats, they lay up Provision against the approaching Winter, and do several other such like actions which conduce to the said end.

The Motions of the first Kind are easily made out, when we affirm that by the sight of such Objects, certain impressions are transmitted through the Fibres of the Nerves into the Brain, which convey the Animal Spirits into the Nerves; which upon turning the Back, or moving the Thighs, are readily disposed to help on the flight; and also partly upon those Nerves which dilate or contract the Orifices of the Heart, or which agitate other parts from whence the Blood is sent into it: That this Blood being rarified, after another manner than is usual, sends into the Brain those Spirits which are adapted to the cherishing and fomenting of Terror, that is, which are apt to keep open, as also to open again those passages of the Brain which conduct them into the said Nerves: So the Sight of the Eye, from the Body of a Wolf, reflected upon the Eyes of a Sheep, hath the force of disposing the Spirits, and diffusing them into the Nerves in such a manner as is necessary for promoting the flight of the Sheep: The like may be said of Chickens flying the Kite; the Lion the Cock, and other Beasts the Lion. For it is the nature of the Brain, and of the contexture of the Fibres, into which an impression is made in the said Beasts, to produce such an affection. And that such a Disposition and Temperament is found in Beasts is sufficiently manifested by the steam exhaling from the body of a Camel, by which a Horse is so terrified, that he becomes incapable of standing a fight: Of such a Nature likewise is the smell of a Horse, that thereby an Elephant is driven into madness: The Root also of the Herb Valerian sends forth a Vapour, which works so upon Cats, that they are thereby driven into a merry Pin, and skip and frisk about like mad. In regard that such or such an affection is not grateful or ungrateful of it self, but upon this account, that there is such or such a conformation of the Organs, and contexture of the Fibres, which is found in these Animals. Nor is it haply for any other cause that the Cock awakes before light, and by his Crowing proclaims the approach of Day, than because the Sun having passed the Circle of Midnight, and having almost overtaken the Morning, puts to flight the cold Air of the Night by his approach; by which coldness the Cock being raised and awakned, is so stirred up and alarm'd, that he presently sets up his Note, and by his loud Crowing calls up mortal Men to their tasks and labours.

By the same reason may the Love of Beasts be set forth, for example, when an Object is agreeable, the Light which is reflected towards the Eyes of the Animal, strikes the Optick Nerves in such sort, that they dispose the Animal Spirits to insinuate, part into the Muscles, which have their course toward the Tail, Head, Legs, &c. part into those which serve to enlarge the Orifices of the Heart, and to press the parts of the Heart, whence the Chyle and the Blood may come in greater abundance; which not only causes the Animal Spirits

VIII.
Whence
arise the
Hatred and
or Antipa-
thy between
some Ani-
mals.

IX.
Whence
proceeds the
Love of
Beasts one
towards the
other.

to mount up to the *Brain* in the greater quantity, but also gives them a freer course into the same *Muscles*, and by this means to conserve, entertain and fortifie those *motions* which the presence of an agreeable Object hath caused.

X. *Whence, their Passions.*
So that the *Passions* of *Animals*, taken not for *Simple Faculties* but for *Actions*, are nothing else but the *emotions* of the *Brain*, caused by the presence of whatsoever Object, whether hurtful or favourable, and fortified by some particular courses of the *Animal Spirits*, which depend principally upon the disposition, which the Heart and others of the Principal Bowels put into the *Blood*.

XI. *The Composition of the Machin of a Beast more exact than any other.*
You will, possibly, have much ado to conceive that *Beasts* should do all that we see them do, after the manner of things Inanimate; as for Example, of a *Clock* which marks the Hours, and strikes by virtue of the disposition of its Wheels, and the force of its Counterweights: For tho' in *Beasts* we take notice only of their *motions*, yet the great number of those *motions* is very surprizing, and it is a hard matter for any one to persuade himself that so many can be included in a *Machin*. But I will easily deliver you out of this pain, if you have the representation before you of a *Clock*, for Example, composed but of 15 or 20 pieces, which nevertheless strikes all the Hours, marks the Half hours, the quarters, and all other parts of Time which are numberless. Now if a *Machin*, which is composed of so small a number of Pieces, is capable of so many things, how many must we imagin the *Machin* of a *Beast* capable of, which is compos'd of *Spring-Fibres*, whose number and due disposeure surpasses, without compare, the structure of the exactest *Machin* that ever was made by any *Workman*.

XII. *The Machines of Beasts are wound up as other Machines.*
If it be answered, that there is a great difference between a *Beast* and an Artificial *Machin*, in that a *Clock* may be wound up every day; but that the *Machin*, for example, of a *Dog*, cannot be so wound up. It is evident, that all *Machines* are not wound up, or renewed after one and the same manner. *Pocket Clocks* or *Watches* have their Springs; certain *Turn-broches* or *Jacks* have the smoke of the Chimney to make them move; *Mills* have Water or Wind; *Thermometers* have heat or coldness of the Air; the *Hydrometer* divers degrees of Moisture: So likewise *Beasts* have their Aliment. So that we may well say, that their *Machines* are wound up as often as they have any thing given them to eat or drink.

XIII. *A Dog is not carried by Cognition onto snatch at a piece of Bread.*
But if there be no difference between *Beasts* and other *Machines*, whence comes it that a *Dog* can snatch at one bit of Bread or Meat, and reject or refuse another bit which is offered him, if he have not a *Cognition* or discerning *Sense* to accept the one and reject the other? Who can think it necessary, that there should be *Cognition* in a piece of *Iron*, to cause it to move towards the *Adamant* or *Loadstone*, and not as well to move towards a *Flint* when it is offered to it? Or who will think himself obliged to admit of *Cognition* in a *Dog*, to cause him to run away at the sight of a *Cudgel*, when it is offered to him, any more than in a piece of *Iron* shunning when the opposite *Pole* is presented, that very *Adamant* by which formerly it had been attracted.

XIV. *A Dog feels never the*
And certainly these who believe that a *Dog* feels pain, because he cries when he is beaten, have

as little reason for their belief; since the greatest sound that can be heard when the *Organs* are touch'd in certain places, is not a sign that there is any pain in those *Organs*: So that there cannot be proposed any such action of *Beasts*, but I can produce something like it, which you must necessarily confess does happen in other subjects, which can no way be imagined capable of *Cognition*; and you need do no more but see with your *Eye*, and touch with your *Hand* the several *Organs* of *Beasts*, and their different Structures, to make you comprehend how the greatest part of their *Actions* may be performed without *Cognition*, after which you will find no great difficulty to acknowledge, that the same may be said of all the rest.

No more doubt need to be made, that a *Swallow* may without knowledge, employ it self in building a Nest of Mud, with the greatest Artifice imaginable; may gather up heaps of Straw and Chaff to make a curious sort of Straw-work, may search about for Feathers to lay a-top, for the making of her Bed the more soft and warm, the disposing of her Eggs, and the covering and cherishing of her Young Ones after they are hatcht, till such time as they are in a condition to fly, and shift for themselves, and seek their own Food; since there are many things that have not the least *Cognition*, which exactly perform that which Men cannot do with all their Ingenuity. I might here recount a world of Examples, but I shall only add, that a *Stone* hung at the end of a *Pole*, marks out the direct way to be kept for to go to the Center of the *Earth*, that the Needle of the Compass points out the *North*, that a Vane shews the Course of the Wind, that a Clock or Dial marks out the Hours more exactly than the Learnedest Man of the World can do. Moreover, there is not a Goldsmith, the cunningest of them living, who having the filing of Iron mingled with that of Gold or Silver, can in the dark separate the one from the other, and even by plain day-light it would cost him much time and labour to effect it; whereas a Loadstone performs the same in a moment, without the help of Day or any other Light. By this we may see that the exactness with which many *Beasts* perform certain operations, is not an undoubted sign that they perform them with *Cognition*: And besides, with what exactness or curiosity soever some *Beasts* may act, they have never produc'd any thing that can come near that rare skill wherewith the least Flower of the Field pushes forth its Bud, its Blossoms and its Leaves.

Nor did ever any *Bee* make Compartments in his Comb more exact and curious than those of a Pomegranate. And if it be so marvelous a thing to see a *Dog* seemingly sensible, when his *Machin* is wholly disposed to move after a piece of Bread, or in pursuit of a *Hare*: So that tho' we perhaps may think our selves obliged to admit of *Cognition* in him, yet it is true, that his whole *Machin*, which is infinitely more strange in its Fabrick, than it is strange to see it go when it is made, hath nevertheless been so composed, as to be without Art or *Cognition*, and to act by motion only, and the disposition of its parts: Moreover the Argument drawn from the exactness with which *Beasts* perform many different Actions, proves too much:

For

more pain, because he cries when he is beaten.

XV. *A Swallow shows nothing of Cognition in building her Nest.*

XVI. *Nor a Bee in the contrivance of its Comb.*

For we should thence be forced to conclude, that *Beasts* have more perfect *Cognitions* than *Men*, as we have said before, and that the principle of these *Cognitions* is more noble than theirs, which certainly no rational person will easily grant.

XVII.
How Brutes
are impel-
led to Gene-
ration.

But let us repeat our Discourse, interrupted by this long digression, concerning the operations of inanimate things, compared with the actions of Animals, and explain the Motions of the *Second Kind*, with the same ease as we have those of the *First*. For that *Beasts* are incited to Generation and Propagation, proceeds from the alteration made in their *Bodies*, by which their *Fibres*, and the Contextures of them are so disposed, that from thence a certain affection is derived, (especially in those *Organs* that are inservient to Generation) which is directed to the foresaid Motions. For *Lust* is a certain disposition of the *Animal Phantasia*, proceeding from the motion of the *Genital Parts*; that is, while those parts are tickled by the fervid Spirits, and impelled to Coition. So when a Proud Bitch is brought to, or comes in company of a Dog, she by her smell so disposes the unquiet Spirits in the Head of the Dog, that they make a conflux into the parts adapted for Generation to perfect the Coition. Whence that *Tentigo*, which in many Males accompanies Lust, is wont to be made by the Animal Spirits, whilst they flow down to the Fungous Nerves of the Masculine Member, and are hindered from returning by the *Prostates*, swelling with the Fervid Seed, and stopping up the Pores of those Fungous Nerves; so that Animals, when they are libidinally inclin'd, are of that disposition, as easily to be directed to those Motions which tend to Propagation, and the preserving of their Kind, as shall hereafter be more largely discours'd of concerning *Birds*.

XVIII.
What Imagination is
in Animals.

When, I say, that Lust is a certain disposition of the Animal Phantasia, I would not have it so understood, as if it were some internal Principle, from whence a certain Imagination should proceed, but only that it is a simple motion, proceeding from the course which the Animal Spirits take of themselves across the *Fibres* of the *Brain*; whence it follows, that the Imagination of Animals, taken for a simple Faculty, is no other than a power which the Animal Spirits have to flow, as of themselves, from the Brain into some certain Muscles, rather than others, for the moving of some particular Members.

XIX.
How it
comes that
Brutes are
concerned
for them-
selves, and
the preser-
vation of
their lives.

With the same clearness may the Motions of the *Third Kind* be made out: For Nature hath been beneficial to all Creatures, in furnishing each of them with their proper Organs, and impressing that habit of Body, by the help of which, and of the said Organs, they are enabled to stir up those Motions, by which they may the better provide for their Life, and prosecute those things which are necessary for the preservation of themselves. It is infused by Nature into all sorts of Animals, as saith the Latin Orator, to defend themselves, and take care of their Life and Body, and to decline those things which seem hurtful to them, and to search after, and endeavour to obtain all things that are necessary for the preservation of Life. Wherefore it is no wonder, if *Brutes*, with so much application, are intent upon their preservation, by building themselves places of abode; by seeking their Food, even rather than fail, by

force and rapin; by providing and laying up sustenance, by discerning and distinguishing some Meats from others, and doing such like actions as tend to sustain and keep themselves from perishing: Forasmuch as *Beasts* are so framed by Nature, that by their Meats, by their Retiring Places, &c. they are disposed to those Motions, from which they use to be prompted to Feed, and to betake themselves to their Receptacles: Whence it comes to pass, that they distinguish the Meat agreeable to them, from that which is not; and that they decline some things, and accept of others: For Example, for the curing of Diseases, and restoring to Health from any Distemper; the *Ring-Dove* and *Blackbird* make use of *Laurel*. For purging the Belly, the *Dog* hath recourse to *Grass*; the *Hen*, to the *Wall-flower*; the *Swallow* useth *Celandine* for clearing the Sight; the *Tortois*, *Origanie* against all sorts of *Poison*: To which choice doubtless, they are only prompted by the very inspection of the Herb, because of the different temper of the Body, and the various contexture of the *Fibres*. Forasmuch as from Trees and Herbs such *Emanations* arise, as are proportionate to the *Sensorium* so affected, and not like those which flow from other sorts of *Plants*; and therefore, as *Animals*, when they are prest with Hunger, are not promiscuously allured by all sorts of Meat alike: So when they labour under any Distemper, they are not by the same impulse carried all to one and the same Herbs, but to those only, by which they are disposed, and in a sort attracted by the peculiar odour which affects them. Nor can any other reason be assigned, why the *Stork* makes use of his Bill and long Neck instead of a *Clyster-Pipe* to purge its self of all Noxious Humours; or why the *Serpent* rubs himself upon *Fennel* to heal his diseased Eyes, except because the ill affection of the Belly and Eyes, prompts, allures and impels to these motions; whence it plainly appears, how prodigal of Reason they are, who allow it to *Brute Animals*, and have recourse to I know not what *Soul*, which must forsooth lie latent in them, and be attributed as a principle to all their works, when as at the same time, there is no mutation to be discerned in them; things are always performed after one and the same manner; variety of place, time and age, produces no diversity in their Operations, which happens not so in Man, as being participant of Reason: There being innumerable ways and modes of Human Actions: And there is not in every Man one only action, or one propensity as in *Beasts*, but in each Man a several Inclination, some proper to one, some to another, according to the condition of the Soul; whence it comes to pass, that there is so great a diversity of Opinions in the minds of Men, so that few Men think one and the same thing, hate one and the same thing, affect one and the same thing: Of the first Class of the Actions of Animals, enough hath been said already; let us now hasten to examin the others, in which there are apprehended some appearances, not only of Perception, but also of Judgment, and Ratiocination, such as are *Dubitation*, *Invention*, *Determination*, &c.

It can scarce be denied, or indeed so much as questioned, but that Animals may sometimes seem to doubt, demur, or be, as they say, at a *Non-plu*. We find that a *Horse*, when two bundles of

XX.
How it is
that Ani-
mals doubt.
Hay,

Hay, or two measures of *Corn* are set before him, makes choice of one and rejects the other; and it is not unpleasant, sometimes to behold a *Cat*, when Meat a little too hot is thrown to her, at a stand whether she should refuse it, or fall to: For first touching it with a light Foot, then nicely putting her Mouth to it, she hesitates a while, with her Ears shrunk up, as it were meditating in her mind which of the two she should prefer, feasting or abstinence, till at length declining the latter, she makes choice of the first, and sticks to that resolution.

These and the like actions, which seem to argue in *Brutes* a liberty and indifference, are to be attributed only to different motions which are in the *Brain*: For different Objects produce different Motions in the Organs of the external Senses, which by the help of the Nerves being carried into the Brain, excite some other motions, by which the Spirits being directed variously, impel the *Conarion*, and so bring it into an *æquilibrium*, so as not to incline more to one part than another: Whence it comes to pass, that *Brute Animals* remain indifferent, and seem unresolved whether to take, or leave their Meat: For since these Spirits are Corporeal, they excite opposite motions in the *Glandule*, which thwarting one another keep the said *Glandule* unmoved, and suffer it not to decline to one part more than another; and this happens not only to *Brutes*, but sometimes also to *Men*, that is, to those, who, being deprived of their Senses, act without Counsel or Design. *MEDINA* makes mention of a certain Madman, who having two Apples offered him at the same time, could not resolve which to fix upon, and so in much perplexity remained a good while in suspense without tasting of either, till at length a certain Friend of his took the Apples, and presenting him with one, reserved the other till that was eaten; whence it evidently appears how different the hesitation of *Brutes* is from the suspension of Judgment. For when by Perception we discover any thing which was hid from us before, and of which we had not yet made any judgment, Our *Mind* by the help of the *Will*, that is, of that faculty which it hath of moving it self, and determining, remains doubtful, and suspends the Judgment; if it apprehends any obscurity in the thing, afterwards deliberates; and as soon as it finds the matter cleared, gives its assent, which it denies to other things which do not appear so clear and evident. But in regard *Beasts* want *Will*, and are only prompted by Corporeal Objects; no wonder they do not in reality either doubt or make choice of any thing with judgment, because not reflexion, but only a recourse of certain Images, causes the said dubitation.

XXI.
The Craft
and Sub-
tily of
some Crea-
tures.

The Craft which most Animals make shew of, and the Wiles which they use in their Actions, are not thought to be made out with the like facility; forasmuch as so great a semblance of Reason appears in them, that some may possibly be induc'd to think, that the said Animals are led by Cognition, and act by an inspection of some end or design. But because the *Fox* excels all other *Beasts* in cunning and stratagems, and is therefore propos'd by some Writers as an example of subtilty, it will not be amiss to relate some of the Tricks and Machinations of this subtil Creature, in regard they being laid open, it will the better appear after what man-

ner the operations of other Animals are brought about. *PLINY* makes relation that the *Foxes* in *Thrace* do nothing inconsiderately, insomuch that being to pass frozen Rivers, they do not presently commit themselves to the hazardous passage of them; but first going softly, and with a light Foot, they apply their Ear and listen the better to make trial of the thickness of the Ice: For when they hear any thing of the murmur of the under-flowing Water, they stop their course, and unless any danger attend them behind, stir not a foot farther; but in case no noise be heard, nor any fear of danger be discovered, they pursue their course and get clear over. For they seem to reason with themselves after this manner: That which makes a noise is moved, that which is moved is not firm, that which is not firm must needs be fluid or liquid, that which is liquid cannot be retained or kept back, but may give way; therefore this River is not to be passed. Another subtilty is related of this Creature by the same Author, in catching and getting possession of its Prey: When-ever he beholds a flight of Birds in the Air, rowling himself in Red Sand, that he may appear all bloody, holding his Breath and lolling out his Tongue, counterfeits himself dead; by which means when the Birds come to settle upon his Body, he on a sudden snaps them, and devours them. Likewise when he is hunted, and the Dogs drive so close upon him, that he is in danger of being taken, he makes use of this stratagem: Having stail'd he besprinkles his Tail with the Urin, then shaking it all about, he endeavours to avert the Dogs by the stink thereof, thereby to free himself from the harm that attends him. The like trick he makes use of to drive the Badgers from their Kennels; as soon as he perceives them gone out, he enters in, and leaves such a stink with the Excrements he voids there, that they are forc'd to make their Lodgings elsewhere. No less Fox-craft is shewn in freeing themselves from the Fleas with which they are oft-times molested: For taking a wisp of Straw, or any sort of soft Stubble, they plunge the hinder part of the Body in cold water, from which the Fleas flying, get up to their Heads, which then they plunge in like manner in the water, upon which the Fleas make their escape into the Straw or Stubble; and by this means the *Foxes* get away and leave their Guests behind them. A greater stratagem than all these the famous Sir *KENELM DIGBY* relates of a Fox, who being hard pressed by the Dogs, entred into a *Warren*, and there hung upon a Rafter among the Carcases of the slain Animals, until such time as the Dogs having lost the scent, were passed by the place. Also of another, who urged by the like necessity, caught hold of a Broom Shrub which shot up over the Mouth of his Kennel, which was plac'd in the broken cleft of a Rock, and to which there was an easier access by another way, and so by an accustomed and well-known passage, slip'd safe into the Hole; whilst the Dogs eager in pursuit, and not suspecting the danger of the passage, fell down among the Rocks to their destruction.

Now that the Cause of these Operations may be the better demonstrated, two things are to be supposed out of what hath been already said; First, That always some affection accompanies the sen-

sitive

XXII.
Passion al-
ways fol-
lows Appa-
tite, and
the altera-
tion of Ani-
mal Spirits
is made in
the Body.

sitive Appetite. For it cannot be otherwise to make every Animal have an Appetite or Aversion, but that some perturbation must spring up in his Body, which taking its source from the Blood and Spirits, dilates or contracts the Vessels or Ventricles of the Heart, and at the same time agitates other parts of the Body; by which it comes to pass, that according to the various reception of Spirits, some passages of the Nerves are incited to an opening or shutting, and thereupon the Animal is rendred prone to follow after or decline: Hence Brutes if they are prest with Hunger, are unquiet, and by the Nerve of the Sixth Conjugation, inordinately agitated in the Ventricle are impelled to the motions of the Members adapted to the pursuit of Aliment. Secondly, When as all the motion of the Body of an Animal is stirred up by the contacts of exterior Objects, it comes to pass that in the Ventricles of the Brain certain Pores are opened by the transcourse of Animal Spirits, which retain a greater facility of opening themselves, than those through which the Spirits have not yet pierc'd: Whence it comes to pass, that if any Object occur, like to that at whose presence those distinct draughts are delineated, the Animal Spirits stirred up into motion, fall into the Vestigia formerly made, and after the same manner as before, move the Members of the Body. As if a Bull, for examples sake, be several times removed from a fertile into a barren and unfruitful Soil; the Stomach being stirred up with Hunger, and pricking the Membrans with an acrimonious Humour, the passages of the Ventricle are twitcht by the Spirits, which being carried to the Brain, and making their Course through paths already formed, represent to the Bull the more delicious Meat formerly fed on, and those more fertile Fields where heretofore he used to feed, and which entering the sources of the Nerves, pass into the Muscles designed for the moving of the Legs, and as it were compel them to make after their former Pastures: For tho' their Memory be not indued with any great activity, and that facility, and those draughts which are impress in the Brain, and which the Spirits leave in the Fibres through which they are carried, may seem to perform little; yet they produce all those wonderful effects which are observed to be in Brute Animals, and induce the greatest part of Mankind to believe that they make use of Cognition, and are govern'd and prompted by some Spiritual latent Principle. Nay, if the matter were thoroughly searcht into and examined, Memory is the effective cause of most of the Actions which we negligently and without attention perform, as I have formerly hinted concerning the *Minstrels*.

These things thus premised, let us return to our Foxes: As for those in *Thrace*, which refuse to commit themselves to the congealed Rivers till they have first made proof of the solidity of the Ice; it is certain that they do not do this by Judgment, but by the benefit of Memory; since it might possibly happen, that the noise of the Water being heard from another place under the same covering, they might notwithstanding their politick listning, fall in and suffer no small prejudice in those Bodies of theirs they take all this care of: Or that in the *Winter* time when they have discovered the course of the Waters, they have

been seized with cold, the Memory whereof smiting their Phantasie, deters them from swimming at that time: But as to their moving their Ear to the Ice to explore the thickness thereof, that proceeds from fear, by which the Spirits being excited, betake themselves to those Muscles which are inferiour to the bending of the Head, and terminate at the Ear which is to be applied to the Ice: Whence it is apparent, that the Fox in this case makes no use of Ratiocination, but is impelled by Affection; is not indued by Cognition, but actuated by Passion alone to such like Motions.

But as to their lying as dead in ambush to catch by surpris the unwary Birds; as to their lifting up and setting their hinder Feet against the stem of a Tree with their Head downward and their Fore-Foots on the ground, and smiting often with their Tail against the Tree, thereby to strike a terror into the Hens, and cheat with a shew of some other Animal leaning against the Tree: As to the shooting the light of their sparkling Eyes upon the Hens, while their whole Bodies besides lie hid in the umbrage of the Night; that being inticed by the said light, they may forsake their Perches where they roost, and lighting on the ground, fall into their Clutches: All this is to be attributed not so much to their Craft as to Chance. For it might probably happen, that a Fox wearied with a long march, might lie down upon the ground and fall asleep, to whom, lying as it were dead, the Hens might very well approach without fear; which the awaking Fox perceiving, still counterfeits himself asleep, the better to take his opportunity of falling upon them unawares. The like luck hapned to a Fox mentioned by P E T R A R C H, which Fox when the Fishermen that carry Fish to the City, as commonly they do in a *Summers* Night, found lying for dead across the way, they took him up, intending to flea him for his Skin, and threw him into the Pannier of Fish, whereof when he had plentifully feasted, out leapt the Fox, and to the great astonishment and vexation of the Fishermen, got clear away with his Belly full of Fish. By the like fortune it might be, that when a Fox saw Hens roosting on a Tree, and not being able to reach them, ran round about the Tree, as seeking some place of advantage whereby to raise himself to a higher station, mean while the Prey fell into his Mouth, and he enjoyed his with without any further trouble. Whence it is probable, these tricks so happily succeeding, that afterwards upon the barking of an empty Stomach, and the instigation of Hunger, the Spirits repeat those passages of the Brain which they entred, when lying as asleep or dead upon the ground, he thereby got his Prey. Which Artifice, often repeated, becomes a custom, and fixes deep into his Memory, so that when ever after he hunts for Food and lights upon any Prey, he repeats the same series of actions, and makes use of the same stratagem, as hath formerly proved so prosperous and successful to him. The truth of it is, many actions which appear not a little strange in Beasts, at first were performed by them, by some certain casualty, which actions having afterwards been made familiar by frequent experience, passed into habits, which seemed to carry in them a great deal of Wit and Sagacity; and such in all probability was the chance of a certain Wood-Fox (mentioned by the

XXIV.

How the
Fox to get
Birds, counterfeits
himself another
Creature.

XXIII.

How the
Foxes in
Thrace being to pass
a River,
lay their
Ear to the
Ice.

the famous Dr. WILLIS) who to get into his Clutches a *Turkey*, pearching upon the Bough of a *Tree*, made use of this device to catch it: He circuits about the *Tree* with a very swift and eager pace, keeping an intent *Eye* all the while upon the *Bird*, and by this means obliged him to return the like intention of aspect, which to do, he was forc'd to turn about his *Head* so often, till at length becoming giddy, and taken with a *Vertigo*, he falls from his *Pearch* into the very *Jaws* of his *Enemy*.

XXV.
How the
Foxes de-
ceive the
Hens by di-
recting
their Eyes
towards
them.

By the same reason it is that *Foxes*, by casting fixedly their *Eyes* upon the *Hens*, either seduce them, or attract them; forasmuch as it was likely enough to come to pass by chance, that while the *Foxes* were prest with *hunger*, and stood gaping after their *prey* that sat aloft, they might so long direct their *Eyes* upon the *Hens*, that they either astonish'd at the *Foxes* sparkling *Eyes*, or struck with suddain fear, might slip down, and fall into the *Jaws* of the *Insidiators*, by reason that the *Hens*, either affrighted by the continual sparkling brightness of the *Foxes* *Eyes*, or thinking themselves already taken by the *Enemy*, are seised with such a sudden astonishment and confusion, that they cease and let fall all their natural *Functions*; as if their *Bodies* had no offices to perform: By which means it happens that they first begin to totter, and immediately thereupon by the solution of the *Nerves* in their *Legs*, drop half dead upon the ground. The same thing is also observed in other *Birds*, who when the *Cats* get upon the *Boughs* of the *Trees*, and thence fix their *Eyes* upon them, as if a suddain *Vertigo* seised them, they drop down from their *Pearches* upon the ground.

XXVI.
How the
Fox pursu-
ed by the
Dogs, comes
to dip his
Tail in
Urin.

As to the Craft of *Foxes*, when they are in danger, watering their *Tail* in their own *Urin*, and sprinkling the *Dogs* *Eyes*, this I take to proceed not from the *Foxes* cunning, but the fear that seiseth him. For it is a common thing among all *Creatures* upon the apprehension of an approaching danger, to let their *Urin* pass from them, as it were unawares; in regard the *Spirits* being then disturbed, are hindered from their wonted *Functions*, and the *Nerves* in the *Bowels* being relaxed, there follows a *profluvium* of the *Excrements*; and whereas upon the said fear they contract their *Tails*, and draw them in between their hind *Legs*, they must needs be soak'd in *Urin*, which upon the shaking of their *Tails* is sprinkled into the *Dogs* *Eyes*, and almost blinding them, hinders their pursuit.

XXVII.
How it is
that Foxes
free them-
selves from
Fleas.

Nor doth that Craft of the *Fox* to free himself when he is bitten by *Fleas*, depend upon a higher cause: For in the *Summer* time, when *itching* accompanied with *heat* is stirred up in his *Body*, to remove the same, he enters into a *River*, where first having found some refrigeration in his *Feet*, he ventures to enter deeper, and by degrees immergeth all the other parts of the *Body*; but to avoid the necessity of plunging in too deep, and the trouble of swimming, which would probably heat him afresh, he carries along with him in his *Mouth* into the *River* boughs of *Trees*, or wisps of *Hay* or *Stubble*, to which the *Fleas* flying for refuge to avoid drowning, and sticking thereupon, leave their *Landlord* clear of them. In the mean time the *Fox* finding his *Limbs* finely

cool'd and refresh'd, returns into the *Wood* from his importunate *Train*, and delivered from the vexatious *itching* that had so lately molested him. Whereupon afterwards mindful of the pleasure and profit he thus received in the *waters*, whenever the like occasion happens, he resolves upon the same method, betakes himself to the same actions, till at length the trick becomes familiar, and by frequent reiteration turns into a habit, because after the *Vestigia* of the *Memory* have brought back upon the *Glandula* the first Image of the thing, the *Spirits* returning by the same passages flow into the same *Muscles*, and so dispose the *Foxes* *Body* to produce the same actions he had produc'd by occasion of the Object that first excited: So that all *Arts* which *Animals* put forth on several occasions, depend upon the observation that comes into their *Memory*, of what before succeeded or not succeeded, as may be demonstrated in *Thales* his *Ass*, who when laden with *Salt*, had a *River* to pass, and by chance plunging somewhat deep in, melted the *Salt*, found himself eas'd of his burthen thereby, by which success being encouraged, he as often as he entered the said *River*, went in on purpose the farther, and rolled himself with his burthen in the *waters*, nor could he be reclaimed from this manner of acting, till in the place of the *Salt*, a Sack of *Wool* was put on his *Back*, which being made more ponderous by sucking in the *waters*, eluded his *Asinine* subtilty, and caused the Master from thenceforth to take new measures, and abolish a custom so incommodious to him.

For when *Sense* or *Imagination* hath disposed the *Animal* *Spirits* to begin their course, the tracts thereof which are formed in the *Brain*, are so much the more deeply imprest, as the *Action* of the *Animal* *Spirits* hath been the stronger, or hath lasted a longer time, or hath been the oftner reiterated; for such strength, duration and reiteration are the causes that these tracts are not easily to be effac'd, and that they are in such sort conserved, that they may be raised there again, a long time after. And thus you have in a few words what it is that occasions the *Memory* of *Beasts*, tho' they are not capable by Discourse or Speech to express it.

As to the trick made use of by the *Fox* to drive the *Badger* out of his *Hole*, that is to say, by staling or voiding his *Excrement*; I find not in the performance thereof, that there can be any necessity of having recourse either to Judgment or Providence, since there is nothing in it but what may be very well effected by instinct of *Nature*: For what is more natural to *Beasts*, than to defile with their *Urin* or *Dung* any place where they have continued never so small a time, if necessity at that time urgeth; so that it need not in the least be questioned, but that a *Fox* entering a *Badgers* *Den* when he is absent, may very well leave a notable stink behind him, and that through the abhorrence thereof the *Badger* may be driven to seek out for another place to *Kennel* in.

I must confess it is not so easie to make out, how a *Fox* should without Knowledge, so industriously defend himself from the *Hounds* following him with a great *Cry*, by intermingling himself (if what is related of him be true) among the *Carcases*, which by chance were hung up in the

XXVIII.
What is the
cause that
Beasts re-
member.

XXIX.
How it is
that the
Fox drives
the Badger
out of his
own Hole.

XXX.
Whether it
be an evi-
dence of
Reason,
that the
Fox when
he is hard
pursued by
the Dogs
should hang
himself up
by the Teeth
among dead
Carcases.

the *Warren*, unless with the Illustrious DIGBY, we grant it might so happen, that the *Fox* through fear or lassitude, seeking out for a skulking hole, and not finding in that plain tract of *Earth* (such as a *Cony Borough* or *Hare Warren* useth to be) any *Bush*, *Bramble* or *Hillock*, or any other place to betake himself to, except that *Animals Gallows* (as we may call it) where such sort of *Beasts* were hung up, might be induc'd, his Phantasie so suggesting, especially when he was driven to the utmost of his Course, to intermingle himself among the said *Carcasses*, which seemed to him in a state of deep repose; and since it could be no other way effected but by hanging himself up by the *Teeth*, he put himself in that posture, and so continued till such time as the *Dogs* running under the place, overshot their *Prey*, which they little suspected to be hanging in the *Air*, and so lost the scent, which while they endeavoured to recover, he by hastning into the next *Woods* and *Coverts*, and getting away by stealth, took another Path, and thereby clearly evaded the danger and freights he had been reduc'd to.

XXXI.
How it is
that the
Fox close
followed by
the Dogs,
had the
luck to
catch hold
on a Broom
Bough
which hung
over a Pre-
cipice.

As to that *Fox*, who from a *Broom Bough* which he laid hold on, threw himself into his skulking Hole (the ordinary place of refuge whenever near it) being so hard prest behind by the *Dogs*, that he could not go the readier way where there was an easier passage in; on the one side, the ingress taking up his whole Phantasie, on the other side the Precipice, which he had often seen, being called to mind, it could not be otherwise but upon the concurrence of these two things, he must needs be admonish'd to use great Caution for his safety in getting into this Hole; and it was but natural for a *Creature* that was to undergo so great a danger, to catch hold upon any thing that might help him in his leap; and since there was nothing that offered it self at that instant besides the *Broom Bough*, which by chance hung over the Hole, he caught hold on the same with his Mouth, and thereby gaining an opportunity of poising himself for the better fetching of a new sort of leap, he threw himself cleverly into the said Hole; mean while the *Dogs* pursuing the *Chace* with the same speed and eagerness as before, were upon the brink of the Precipice before they perceived there was any danger there, in which extremity, neither being able to retreat back, nor to put a stop to their career, they fell in and perish'd in their fall. Yet all this while there is no necessity to imagine, that the *Fox* contrived this destruction for them, or brought them designedly into this destructive Path; but in the first place it was effected by his meeting with this refuge from the hard pursuit of the *Dogs*; and next he was prompted by his *Memory*, which had upon some such like case before suggested to him, how to shift for himself when-ever the necessity of declining the like danger should require.

XXXII.
Certain
Phenome-
na which
indeavour
to prove
that Ratio-
cination
belongs to
Brutes.

And here what hath been already said, induceth us not to pass by certain *Phænomena*, by which some take upon them to attribute to *Brute Animals* the faculty of *Ratiocination*, and judge them to be induc'd not only with *Cognition* and *Perception*, but with *Discourse* also. For example, when a *Dog* hath two ways to go in quest of his *Master*, he thus seems to reason with himself; my *Master* certainly went one of these two ways,

as is evident from the scent of his *Footsteps*, but he went not this way, therefore he must needs have gone this way. And when a *Dog* in pursuit of his *Prey*, comes to a threefold Path, the first and second being smelt to, and found not to be the right, he immediately without delay, or putting his *Nose* any more to the Ground, takes his progress through the third. But the real cause of these two actions is no other than the instinct which *Nature* hath infused into these sort of *Animals* to perform such and such actions.

For in regard a Scent evaporates by a continual effluvia from *Man*, *Hart*, *Buck*, *Hare*, &c. and adheres to other things, the *Dog* hunts out the scent of *Master*, *Hare*, *Hart*, &c. impress'd upon the *Vestigia* or *Footsteps*, and being not in the least moved by the scent of the traces of any other Body, no wonder if he take that way by which his *Master* or the *Hare* went. Nor is it to be objected that the *Dog* doth not this by his Scent, but only induc'd by this sort of reasoning, *The Hare hath made his escape by one of these three ways, but he is not gone this way nor that way, therefore it must needs be that he hath made his escape by the third way.* Forasmuch as this is but a meer fiction, and not the reasoning of a *Dog*, but of a *Man*: For the *Dog* is no other ways but by the scent led into that Path to which he is induc'd by his quick scented *Nose*; for when he finds it, he pricks up his *Ears*, and with great speed pursues his *Prey*, because the vapour of the scent filling his *Nose*, he hath no more to do, but to give himself the loose and follow the tract of it. Whereby it evidently appears, how different this way of Operation is from *Discourse* or *Ratiocination*; since the *Dog* advances not from one *Cognition* to another, nor discovers any unknown Verity by the help of another known. For such a power is capable of *Intellect*, because of its *Perception*; and of *Will*, because it applies the *Intellect* to *Inquisition*, and *Consideration* of its Object. Which Faculty seems to be instead of a consequence of a *Created Mind*. For *Brute Animals*, as LUDOVICUS VIVES observes in his Second Book *De Anima*, begin not from *A* and so pass on to *B* to know *C*, nor from *B* as conjunct and proceeding from *A*, but because *A* pleaseth not, they seek another thing, and so fall upon *B*; as when a *Dog* follows his *Master* hunting after a *Wild Beast*, he both by scent and sight discerns him to be a *Man*: If it be correspondent with the scent and aspect of his *Master*, he rests satisfied, tho' it be not the very same person; but if otherwise, leaving him, he betakes him to another, thence to another, tho' having no coherence with the former, till he lights upon him whom he seeks.

Among the subtle Wiles of *Brute Animals*, the Craft of the *Torpedo* or *Cramp-fish* uses to be made mention of. This *Creature* is skulking in muddy places, the better to lie in wait for small *Fishes* which it feeds upon, casting such a numbness upon them, that as soon as ever they rise above water it easily catches them, and devours them. Moreover, the Writers of the Wonders of *Art* and *Nature*, deliver of this *Fish*, that by touching only the Line of an *Angle Rod*, let down into the *Water*, it conveys quite up to the very Hand of him that holds the Rod, such a

XXXIII.
How it is
that the
Torpedo
catches
other Fishes.

benumbing quality, that be he never so strong a *Man*, he finds all the *Joints* and *Sinews* of his *Hands* and *Arms* so enfeebled, as not to be able to hold any thing in his *Hand*, and so likewise in his *Legs* and *Feet*, as not to go at least with any speed or swiftness of pace. The Cause of all which it will not be very difficult to demonstrate, if we consider that it is Natural to this and other sorts of *Fish* of a cold Nature, so to cover and as it were arm themselves with *Mud*, that the *Fishes* when they approach, are upon the emission of this Venenous quality, immediately seiz'd with such a Numness as if they were all frozen and bound in *Ice*. Forasmuch as such sort of *Spirits* are emitted from the *Body* of the *Torpedo*, as penetrating the substance of the *Fish*, or reaching the *Hands*, *Feet*, or other *Members* of those that touch, benum their *Spirits* coming forth to meet them, and consequently stupifying those parts of the *Body*, render them feeble, tremulous, and unapt for *action*, and that so thoroughly, that the business is effected before the *Fish* are taken either by *Net* or *Angling-Rod*. The same may be said of the *Sepia* or *Cuttle-Fish*, who finding danger approaching from the hands of the *Fisherman*, sends forth a certain black *Liquor*, by which the *Water* being all ting'd, and putting on a black or sable Hue, he dexterously failing all the *Arts* of the *Fisherman* gets away safe and secure. But neither doth this Stratagem any more, than any of the rest, proceed from any Discursive Faculty or act of Reason, but from a laxation or loosning of the *Nerves*, caused by *Fear*; as hath been already discours'd concerning the *Fox*, who for fear voids his *Urine*; so the *Cuttle-Fish* vomits out a *Liquor* much like *Ink*, from the diffusion whereof through the *Waters* proceeds the fore-mentioned Effect.

XXXIV. Neither doth it argue more of Reason, that *Beasts* stand in fear of *Men*, and usually fly and decline the sight of them as *Enemies*, since that fear proceeds from the remembrance of some damage which at some time or other they have received. For the Cause of Passions, as well in *Brute Animals* as in us, is nothing else but the Agitation by which the *Spirits* stir up the *Glandula* which is placed in the midst of the *Brain*, from the inequality of whose agitation, and the variety of parts whereof they consist, the *Spirits* themselves are diversly deduc'd into the *Muscles*, and create different Affections. Whereupon, when the *Spirits*, which constitute the *Idea* of any thing, have once form'd a way to themselves, and intruded themselves among the *filaments*, of which the substance of the *Brain* is compos'd, there is not requir'd so great a force by which they are oblig'd a second time to repeat that way, as was needful at first to prepare the said way for them; whence it comes to pass, that when the like *Species* shall be form'd upon the *Glandula*, that facility alone which they find of advancing through their first path, will suffice for them again to enter it. Wherefore, no wonder if *Brute Animals*, for damages offer'd them by *Men*, or Terrors thereby incur'd, are not able for the future to look upon them, but that the *Idea* of the harm must presently occur, and they thereby be stirr'd up to flight; as we see in some *Men*, who having drunk a *Medicin* with great aversion, cannot after that eat or drink any thing that hath the like kind of taste or savour, but with great

abhorrence and aversion; nor can in like manner so much as think of the aversion usual in taking of such *Medicins*, but that the same must return again into their *Minds*. And that this is the true and genuine Cause why *Beasts* fly the sight of *Men*, may hence be confirm'd, viz. because there are many *Regions* discover'd (especially in the *New World*) where it is found by Experience, that neither *Birds* nor *Beasts* do in the same manner fear or fly the sight of *Men* as among us, who treat them more inhumanly, and suffer no place where such Creatures harbour to be at rest from our *Fowling-Pieces*, and our *Venatory Instruments*. Moreover, it is observ'd in the *Island* of *Chio* and other places, that *Partridges* never fly away, but are kept tame in great *Covies*, and oftentimes betake themselves in great numbers into thick inhabited and frequented *Towns* and *Villages*, no otherwise than as *Sheep* are fed and kept in *Folds* among us.

But there remains yet one Difficulty to be solv'd; for tho' *Beasts*, who have suffer'd injury from *Men*, may by the benefit of their *Corporeal Memory* be affrighted at the sight of *Men*, and upon discovery thereof betake themselves to flight; yet how comes it, that young *Animals* who have not seen the Face of *Man* before, should shrink back and be shy at the sight of what they have not yet seen? For the solution of this Difficulty, it will be sufficient to mind what hath been discours'd in my *Philosophical Institution* and *History of Nature*, concerning some *Sympathies* and *Antipathies* of *Men*, namely, that the *Image* of a thing seen being depainted in the *Brain*, is by the help of the *Animal Spirits* convey'd into the common *Sensorium*, or Seat of the *Sensus Communis*, and from thence by the mediation of the *Blood* and *Spirits*, to the *Uterus* or *Womb*, and through the *Umbilical Vein* to the *Birth* it self, in which the *Image* of the thing seen, because of its softness is strongly imprinted, which tho' in the beginning it be but small, yet by little and little the substance of the *Birth* being enlarg'd, it increaseth just as a Letter engraven with a *Penknife* in a *Pompon*, or the *Barks of Trees*, is dilated, and by degrees receives Increment through the *Bark*. For it cannot be doubted, but that *Brute Animals* having receiv'd damage from *Men*, or an impression of *Fear*, transmit the *Species* thereof into the *Birth*, forasmuch as by those motions their Temperament is alter'd, and the disposition of Parts inverted, which afterwards being communicated to the *Birth*, by the *Seed*, generate the same propension therein. For we see it happens very often in the *Sons of Mathematicians*, that they are more delighted than any other sort of *Men* in the *Drawing of Figures*, and designing of *Proportions*, and that they are led as it were by a certain Instinct of *Nature* to the learning of those kind of *Arts*, which undoubtedly from their *Nativity* they are addic'd to, and that upon no other ground but from the *Imagination* of the *Parents*, which altering the *Nature* of the *Seed*, and inverting the *Temperament* of the whole *Body*, imbues the *Birth* thence springing with the same propensities.

The time now requires, that we should pass on to the third *Classis* of *Actions*, that is, of such as *Animals* attain to by Exercise and Discipline, and which seem so wonderful to those that observe and consider

XXXV.

How it comes to pass that young Animals, who never saw Men before, should fly them at first sight.

XXXVI.

How some Beasts come to be so Capable by Instruction and Discipline.

consider them, that they can hardly be otherwise persuaded, but there is *Cogitation* in these *Creatures*. The *Hawk* is taught by his *Instructor* how to hunt after *Partridges*, and other sorts of *Birds*, and with erected *Ears* receives his *Instructors* words, and when he is let fly to catch the *Prey*, upon the *Falconers* hortatory Outcries, encouraging him still to a stouter prosecution of his work, he grows fiercer and fiercer, and follows the *Enemy* with an extraordinary ardour of *Spirit*. The Famous *Justus Lipsius*, in his first Century of *Epistles* to the *Hollanders*, makes mention of a *Dog* of a *British Race*, who was taught to go to *Market*, to carry the *Money*, and to bring home the *Meat*. It was thus perform'd: They hung a *Handbasket* about his Neck, with *Money* in it for so many Joins of *Meat* as there was occasion for; with this the *Dog* goes directly without stop or stay into the *Market*, to a known *Butchers- Stall*, there receives the *Meat*, and away comes the *Dog* with his *Marketing* home. *Setting-Dogs*, who have an innate Inclination to set upon *Partridges*, are so taught by Art, that upon the sight of them they are to stand unmov'd, and never till the Sign be given, to rise or move a Foot. *ARRIANUS* is Cited by *CARDAN*, as relating that he saw an *Elephant*, who having two *Cymbals* in his *Ears*, toucht them alternately with his *Snout* or *Trunk*, to a certain *Tune* that was set for that purpose, and danc'd to the Measure of the said *Tune* in Confort with others that were engaged and had a part in the said *Dance*.

XXXVII.
The Cause
of the di-
versity of
Motions
in Ani-
mals.

These Operations in *Animals* will be more clearly made out, if it be granted that the double Nature of *Brutes* proceeds from the different texture of the *Fibres* and quality of the *Humors*; whereby it comes to pass that some are more propense to one Motion of *Passion*, others to another, to which the unequal commotion of the *Spirits* in them doth not a little conduce. For since some of those parts of which the *Spirits* consist are more gross than others, and rais'd to a quicker Motion, the said *Spirits* pass on by a direct Line into the *Cavities* of the *Brain*, and from thence are led into other *Muscles*, into which they had not been led had they been endued with less force.

XXXVIII.
How a
Hawk is to
be brought
up for the
better
catching
of its
Prey.

The *Hawk* therefore being a *Creature* Voracious by Nature, and adapted by Kind to follow *Prey*, is without any difficulty taught to bring it to us, if we contribute to the improving its Nature, and accommodate our selves to its Inclination, since this whole business chiefly consists in this, namely, to keep the *Hawk* as much as may be from *Sleep*, and almost continually to be stroaking it, so to make it to become Tame to that degree, as scarcely to take any *Meat*, but from the *Fist*; which familiarity being for some days used, it becomes accustomed in time to fly after its *Food*, thrown at some distance from it: In the next place, to hunt after a *blind Pigeon* let loose before it, which if it catch, that being snatcht out of its *Talons*, another piece of *Flesh* is cast before it, to feed upon, as given for a reward of its Labour; which Exercise being for some time repeated, the *Hawk* accustoms himself by degrees to fly after all *Birds* whatsoever, and when taken leaves them for the *Master*, being himself contented with a small Reward. Whence it is to be concluded, that all

this work consists chiefly in this, That the *Hawk*, as is inbred in him by Nature to do, accommodate himself to the Art, and follows that Rule of feeding which Nature hath prescribed potentially, but which is improv'd by the Instruction by us given for our advantage and pleasure, in which obsequiousness of the *Hawk* nothing of Reason is to be discern'd, but only the Industry of the *Instructor* appears.

As to those *Animals* that are capable of Discipline, as are *Dogs*, *Elephants*, &c. it must be consider'd, that the Discipline whereof they are capable depends principally on the 7th pair of *Nerves*, for from thence it is that the *Nerve Auditive* hath communication by its Envelopement, and, it may be, likewise by its *Fibres* with the Branches, which advance some to the Exterior Ear, others to the *Muscles* of the *Larinx*, others to other parts of the *Body*; and hence it is that *Animals*, when they hear any *Noise*, cannot but erect their *Ears*, utter their *Cries*, and move themselves after their several ways; the Reason is, because when the *Nerve Auditive* is touch'd and excited, the other *Nerves* with which it hath communication are mov'd in such sort, that the *Animal Spirits* are disposed to flow into the *Muscles*, which serve for the Moving of the *Ears* and other *Members*.

This Communication of the *Nerves* of the *Hearing* with that of the *Voice*, and other parts being granted: It is evident that when we see a *Dog* ready, for Example, to catch hold of any thing, there needs no more to be done, but to shew him a piece of *Bread*, and to cry at the same time that he is in this posture, *Hold fast*, for the *Noise* of that *Saying* will not fail to cause the *Animal Spirits* to flow across from the *Brain* at that very time that the presence of the *Object* causeth others to flow into the *Muscles*, which serve to make the *Dog* catch hold, which being reiterated several times, the habit thereof may in such sort joyn the two Courses of the *Animal Spirits*, that at last the only uttering these words, *Hold-fast*, will be capable not only to excite the Courses of the *Animal Spirits*, which are answerable to one another, but also that which serves to cause the *Dog* to Catch hold without any necessity of the *Bread* being there.

By the like Care and Art *Dogs* are taught to carry *Letters* and other things to any certain place, as *LIPSIUS* reports of the *Dog* at *Brussels*, who doubtless was brought to it by continual Use and Custom. There is no question, but a *Master* or *Servant* taking a *Dog* along with him to the *Shambles*, gave him *Meat* for a reward of his Labour, and afterwards hanging a *Hand-basket* about his Neck return'd with him to the same place, and renew'd the Reward; to which Service the *Dog* was so accusom'd, that whenever the said *Basket* was hung about his Neck, he made to the *Shambles* of his own accord, and having received his Burthen, return'd home. But no Man I think will attribute this action to Judgment or Reason, but only to Assuefaction or Custom gain'd by long use, which may be easily evin'd from the Event: For if it hapned, as the same *LIPSIUS* observes, that in his way home other *Dogs* invited by the scent should come smelling about him, and set upon him to take it away, then must he be driven either to defend

XXXIX.
How Ani-
mals are
capable of
Discipline.

XL.
How we
are to con-
ceive of
a Dogs
Catching-
hold of a
thing.

XLI.
By what
Art the
Dog at
Brussels
was taught
to go to the
Butchers
and bring
home Meat.

defend the *Basket* and put the *Invaders* to flight; or if overcome by number or strength, to fall in with the rest and take his share of the *Prey*; by which it is evidently demonstrated, that the Image impress'd in his *Brain*, of carrying the *Basket* to his Master, was disturb'd by another stronger Image, namely of repelling the *Invaders*, which latter Image a third yet follow'd in order, to wit, of taking share of that *Flesh*, for the preservation whereof he had a little enter'd *Combat*, that is to say, this last Image conducting the *Spirits*, which are intervant to the Motion of the *Body* into the *Muscles*, another conformable Action object'd, was produc'd, which was at the same time delineated in the *Brain*, and this could be no other, than that of partaking of the *Flesh*, which as the case then stood was represented as the most convenient and profitable for him. And not much unlike this last, was the Education of another *Dog* mention'd by *PLUTARCH*, who was so well Instructed, to represent *Arguments* and *Persons* in a *Scene*, that no *Stage-Player* could do it more neatly and exquisitely, and particularly he took upon him the person of a *Man* that took Poyson in a piece of *Bread*, that is to say, a Morfel of *Bread* dipt in a *Liquor* which was feign'd to be *Poyson*, upon which he counterfeited to tremble, to totter in his gate, to be taken with a deadness and heaviness, and in the end he fell, and with his Limbs stretch'd out lay for dead, then was removed and laid out as for *Burial*, as the Argument requir'd; yet after all this, when nothing less was expected, in the twinkling of an Eye, he first came to himself as it were out of a *Dream*, began to move his *Head* and *Members*, to open and roll his *Eyes* about, and lastly arose and went joyful and brisk, to shew himself to him for whom he had done all this.

XLII.
How a
Dog is
taught to
See for
Partridges.

But to proceed farther, That some *Animals* are taught to act contrary to their own proper *Instinct*, and omit that which they seem to be impell'd to by a certain force of *Nature*, doth no more than the rest evince, that they are any way endued with *Reason*; since we see in *Men*, that divers Motions of *Fibres* or *Spirits* which represent Objects to the *Mind*, or excite certain *Affections*, do by long use, and sometimes also by accident, excite other successive Motions. For although the *Motions*, as *CARTESIUS* excellently, after his manner, affirms in his *Treatise of the Passions*, both of the *Glandule*, *Spirits* and *Brain*, which represent some certain Objects to the *Soul*, be naturally joyn'd with those which excite therein certain *Passions*; nevertheless they may by *Habit* be thence separated, and be joyn'd with others of a very different Nature; nay, this *Habit* may be acquir'd by one only Action, and that without long use. As for Example, when on a sudden and beyond Expectation some very loathsome thing shall be found in *Meat* that is eaten with a very greedy Appetite, this sudden chance may so alter the disposition of the *Brain*, that thenceforth the very sight of that *Meat* may possibly not be endur'd, which formerly was eaten with great delight, which very thing is also observ'd in *Beasts*: For tho' they are void of *Reason*, and all manner of *Cogitation*; yet all Motions of the *Spirits* and of the *Glandule*, which excite *Passions* in us, are also in them, and serve for the preserving and confirming, not as in

us of the *Affections*, but of the Motions of the *Nerves* and *Muscles*, which use to accompany them. So when a *Dog* sees a *Partridge*, he is Naturally inclined to run after it, and when he hears the sound of a *Musquet* shot off, that Sound naturally disposes to flight; yet it is an ordinary thing for a *Setting-Dog* to be so Instructed, as to stop at the sight of a *Partridge*, and on the other side, to run after any thing shot out of a *Gun* upon hearing the Report thereof; to do which they are not led by Judgment, as I said before, but by the fear of *Stripes*, or some kind of Discipline, by which the Motions of the *Spirits* and *Nerves*, joyn'd by Nature with certain impressions of Objects, are totally diverted and remove into other parts.

But that an *Elephant* should beat upon *Cimbals* tied to his *Ears*, is no great matter of Admiration, since by a small deal of Industry and Discipline he might easily be brought to it; in regard this *Animal* is of a very capacious and hot *Brain*, and consequently easily imitates those things which are propoted to it. Add hereunto, that he hath a prompt and ready *Proboscis*, capable of touching the *Cimbals* alternately, and thereby producing a certain rude, if we may so call it, *Harmony*, by which all those who were present were induced to a *Dance*, according to the *Laws* or *Rules* aforehand prescribed.

XLIII.
How an
Elephant
is taught
to beat
upon Cim-
bals.

From these few examples it plainly appears, that Cognition is not required to the performances which we behold in Brute Animals; but that *Memory*, the *hability* of the Members of the Body and Custom suffices: Or if any one will needs call them the works of Reason or Intelligence, they may indeed be so allowed, but not of the Reason of the Animals, but of those who have instructed and taught them. Now if any one will have it, that Beasts are taught some actions by example and the imitation of others of the same Kind, and by institution; *VIVES* answers them in the above cited place. Brutes, saith he, teach their Young Ones to do that sooner, which nevertheless they would do of themselves; as a Bird teacheth her Young Ones to fly, a Cat her Kittens to hunt after Mice, that they may have the benefit of seeing them like themselves as soon as may be, that is to say, perfect in their Kind; but we teach them to do what we would have them do, which they else would either never do, or at least in another manner than we design. Nor is our Doctrin any other thing in them than meer *Assuefaction* or accustoming themselves, and that to nothing else but to some Corporeal Exercise, as to Speak, to Run, or in some manner or other to move their Body, or some part of their Body.

XLIV.
The Cause
of these
Operations
in Brutes
is only
Memory,
and the
disposition
of the
Parts of
the Body.

As to that manner of Speech or Discourse by which some Animals seem to speak to one another, and to discover thereby what their thoughts or designs are; this appears most clearly in the Hen, who according to pleasure varies, and by divers Tones makes manifest the several Affections where-with she is impelled; for if she calls out her Chickens, she feigns the Tone of a Raven; if the Kite be hovering over her, she drawls out, and somewhat elevates her Voice; if the Chicken chances to be catcht, she as it were groans and repeats that Tone with a kind of a Sob, &c. Hence *PORPHYRIUS* imagined, that Animals had converse

XLV.
By some
Examples
it is shewn,
that Beasts
discourse
one ano-
ther, and
understand
Human
Speech.

converse with each other by Speech, and that *Thales*, *Melampus*, *Tiresias* and *Apollonius Thyaneus* understood their Language, as *Virgil* relates of *Helenus*, in the Third Book of his *Aeneids*,

—Who knowst the Stats,
And Speech of Birds.

A Parrot falling out of a Window, in *Whitehall*, in the time of King *Henry VIII.* into the River *Thames*, flowing by the said Palace, began to cry out a Boat, a Boat, 20 l. for a Boat; whereupon being taken up all wet by a Waterman, he was brought to the King in expectation of the promised hire, but the Parrot, then altering his Tone, cried out, Give the Knave a Shilling. A Magpie sometimes so exactly imitates the Voice of the Fowler, as thereby to impose upon the Dogs, and draw them on, while they take it to be the Voice of the Master. The same thing *PLINY* relates of the *Hyana*, who counterfeiting Human Voice among the Shepherds Cottages, and having learnt the Name of some particular Person, calls him out by the said Name, whom coming forth by Night, he sets upon and tears to pieces. *Horses*, *Dogs* and *Apes* we find understand very well the speech of Man; forasmuch as they receive all their Dictates and Commands, and accordingly execute them. An Example hereof *JUSTUS LIPSIUS* gives us in a Dog at *Lovain*, who having letters sowed up in his Collar, and understanding by the words spoken to him, whither they were to be carried, went directly to *Brussels* with them, to a certain House well known to him, and there left them.

XLVI.
How a Hen
varies her
Voice.

That certain Animals do as it were attempter and manage their Voices, and seem after a sort to utter various sounds at pleasure, is not to be supposed to proceed from Reason, and as if there were a certain Mind latent in them, by which their sounds were directed, but only from the Passions by which they are agitated: Which Passions inducing a various disposition in the Organs, are the cause that the Spirits are diversly emitted through the *Aspera Arteria*, and accordingly Beasts utter their various Tones, even as we experiment in our selves, who inflamed with Love, speak after one manner; affected with Hatred or Anger, after another. And altho' Cogitation may accompany the Motions of our Passion, that is to say, in regard we are indued with a faculty of thinking, yet it is most evident, that those Motions do no way depend upon this Cogitation, in regard they oftentimes arise against our Will, and consequently the said Motions may very well be in Brutes, nay, and possibly more vehement than in Man. Yet can it not be from thence concluded, that they are indued with Cogitation. Different is the *Pipation* of a Hen, in regard she is affected with one Passion when she falls upon her Food, with another when she sees the Kite, with another when she is taken, with another when she calls away her Chickens, with another when she goes to Roost: So that we can never enough condemn those Persons of Vanity, who in Ancient Times have taken upon them to understand the Languages of Beasts, and pretended to know by their manner of Speech what they designed or acted.

Parrots indeed are taught to form articulate sounds, and by Custom are brought to pronounce many words, and yet they cannot properly be said to speak. For to Loquution or Speaking, two things are chiefly required, *Motion* of a Corporeal Organ, and *Perception* of Mind. For as in Sensibility there are three Degrees to be distinguished, as I have already hinted, viz. *Motion* of a Corporeal Organ, *Cogitation* of Mind, and determination of *Will* to judge; so in speaking, the first Degree is Perception of Mind; the second, Judgment and Will to discover to another that which we conceive; the third, the Motion of the Corporeal Organ. Now in some Animals there is the third Degree of Speaking, but not the second or third: Because whereas Beasts are void of Mind, they design not by those words which they utter, to discover their internal Conceptions, but only declare those things, which by long labour they have learnt of Men, and whose signification, in time, utterly slips from them: For if some Birds have been so instructed, as to give some things their right Names, and promptly to answer to Questions ask'd them, this is only to be attributed to their Memory, no to their Understanding or Reason; as particularly in that Parrot, who, falling out of a Window of the King's Palace into the River of *Thames*, called out for a Boat, since there is no doubt, but he had formerly learn'd to pronounce those words, whereby it came to pass, that the species of them being by very frequent repetition imprest in the Brain, the Spirits and Organs were determined to put forth the like sounds. As in that Magpie, which upon the sight or approach of his Mistress, used to utter the word *Χαίρε*, i. e. God save you, in regard this Sound or Voice accompanied such an affection, namely the hope of some good thing for the Belly, in regard that upon the uttering of this word he had been always used to be presented by her with some or other more delicate Bit than ordinary. In like manner, all those things which Dogs, Horses, or Apes are taught, are no other than the Motions in them of Hope, Fear or Joy; in so much that there is not in the least any need of Cogitation in them for the performance of these things.

XLVII.
Parrots do
not properly
speak.

As for the Magpie, *Hyana*, and such like Creatures imitating Human Voice, it can be attributed to nothing else, but to the sensitive plexus or texture of the Fibres, and the disposition of their Organs. For their Bodies are so disposed, that when a human sound or accent smites their Ear, the Animal Spirits conduct it into the Muscles which are inservient to the formation of the Voice. And that the *Hyana* should with a Voice, much resembling human, call forth Shepherds to make a Prey of them, arises from hence; that his Stomach being empty, the species of those Animals on which he used to feed, causes the Glandule, inclining it self to impel the Spirits into that part of the Brain in which are the Vestigia or Tracts which the aspect of these Animals left; and since the Image of the Object recurs not to the Brain, but when that also recurs which accompanied it: No wonder the *Hyana* should feign or imitate Human Voice, being indued with a wonderful docility of Corporeal Organs, and able promptly to express what ever comes to the Ear.

XLVIII.
How the
Hyana
counterfeits
Human
Speech for
the devour-
ing of
Shepherds.

8 F

Thus

XLIX.
How is it
to be under-
stood that
some Ani-
mals have
more In-
stinct than
others.

L.
How it
comes that
Dogs, Horses
&c. obey
our Words,
and execute
our Com-
mands.

LI.
Certain
Actions of
Animals,
wherein
they even
seem to ex-
ceed Men
in Sagacity
of Wit.

Thus when they say that these Animals have more of Instinct than others; nothing else is to be understood, but that the interior and secret disposition of the invisible parts of their Bodies, and principally of their Brain is such, that it receives more easily the different impressions of exterior Objects, and causes the Members to move in more different manners than those of other Animals.

Horses, Dogs and Baboons, upon certain words or signs given, obey us, and execute our Commands; nor is it therefore just to conclude, that they are indowed with Reason and Intellect, because we find by experience, that if other signs be given them, which tho' in reality more facile, yet are not suited to their innate capacity, they take no notice of the Commands there hinted. For Examples sake, if we should command a Dog to seek out for a Handkerchief lost a Month ago in a Garden, Closet or such like place, as we usually command him to fetch a Stick, just now thrown into a Pond, the Dog, instead of speeding to the Garden or Closet, where it is signified that the Handkerchief was lost, will doubtless make directly to the Pond to look out for the Staff: Whence it plainly appears, that the Dog does not perform what he is commanded, as apprehending the Words spoken or Signs given him; but because the whole *Machin* of his *Body* hath obtain'd that *habit* and *disposition* by Labour and oft repeated Instructions, so that as soon as the Sign is given him, the *Animal Spirits* are streight carried into the *Nerves* and *Muscles*, which dispose him to the doing of this or that thing; and so no wonder if the Dog of *Lovain*, having the Letters made fast to his Collar, made streight for *Brussels*, went to the House assign'd, and having discharg'd himself of his *Letters*, return'd directly to his Master, since all things which we see done by *Beasts*, and which so much stir up Admiration in us, are the meer effects of their *Passions* and *Motions*, by which we teach them and have a curb upon them, through the long exercise, labour and use which we are at in the instructing of them.

There are now remaining to be Explained those Actions of *Brutes* which constitute the fifth Class, namely those Actions wherein they discover so much acuteness of Wit, that they seem even to exceed in that Rationality by which *Men* are commonly differenc'd and distinguished from them. In the first place it is admirable to see how delicately and ingenuously some *Birds* proceed in making of their *Nests*. For Example, when the *Swallows* begin to be sensible of that alteration of their Condition, which desire and eagerness of Propagation is likely to bring upon them, they design their *Nests* after this manner: The biggest *Straws* and strongest of the *Chaff* being first laid as a foundation, they afterwards lay the softer and the lesser over: To this *Fabrick* they use Mud for a Cement, and daub their *Nest* all over with it, as with *Mortar*, and when this *Mud* is wanting, they fly to the next *Pond*, and there wetting the end of their *Wings* gather up *Dust*; with which as with *Mud*, they plaister up the rough places, close up the gaping Holes, and in all their Architecture so accommodate the dimension of their *Fabrick* to the shape of their *Body*, that they may have room to turn round so as commodiously to

hatch upon their Eggs, and in such manner to plant themselves, that they may distribute an equal force of heat to all parts. And now their Nest being strewed with Chaff, Moss and Feathers they lay their Eggs, sit upon them, hatch their Chickens, and feed them. Another argument of Providence in Animals is, that upon the approach of *Winter* they remove into foreign Regions, the better to consult for their advantage and subsistence. Of this sort are the *Cranes*, who every year in *Spring* time fly from *South* to *North*, and in *Autumn* fly back from *North* to *South*. The third Argument is, that some Animals preface things to come, and by a certain Cognition foretel those *Phænomena* in the Air which hang over us; as the *Heron*, when she flies very high, and soars more than usually above the Clouds, predicts future Rain. The *Kite*, on the contrary, mounting up to the highest Region of the Air, and there hovering till the Evening, proclaims fair Weather. The same thing we find by experience of other Animals; for Example, the *Cat*, the *Mole*, the *Bull*, the *Ram*, the *Dolphin*, the *Duck*, the *Cock*, &c. which either by Voice uttered, by Crowing, by Frisking about, or the like, preface various sorts of Weather.

As to the Birds building their Nests at a certain season of the year, afterwards fitting upon their Eggs, hatching their Young Ones, nourishing defending and covering them, &c. this ariseth only from the mutation of the temperature of their Body; by which the Fibres, and their Contextures, in those Organs, especially which serve to Propagation, are so dispos'd, that that affection is easily thence derived, which prompts them to build their Nests, brood upon their Chickens, feed them when hatcht, &c. For to close with the Sentiment of the most Noble DIGBY, I think there is no Man will deny but that the desire of Copulation in Birds, proceeds not from any impulse or design of begetting their like, but from the temperament of the Blood and Spirits, produc'd by quality of the Food wherewith they are fed, together with the Season of the Year; however, after Copulation it must of necessity follow, that the Eggs grow in the Belly of the Female, and still increasing create trouble to her, and stir up a desire in her of being at rest, and of freeing herself from the burthen she labours with. And as *Dogs* and *Cats*, when necessity urges, are wont to look about for some commodious place, not only for the bringing forth of their Young, but also for voiding their Excrements. So *Birds* when the weight of their Eggs burthens them, and renders them unapt for flight, begin to indulge themselves very much to their repose, and take much delight in soft and warm places, so that Chaff, Moss, and the like, please them with their softness, which they therefore carry to their Nest. But that this action is not guided by Reason, is evident even from the very manner by which it is performed: For when they light upon Chaff, or any other thing commodious for the Litter of their Nests, they do not, as I have often observ'd in several Birds, carry it directly to their Nests, but first make towards the Bough of some Tree, or the Top of some House, and there with this piece of Householdstuff in their Bill, hop up and down for some time, then leaving this place, fly to another,

LII.
With what
impulse
Birds are
carried in
building
their Nests.

another, where after a small time of some such like diversion, they at length betake themselves to their Nests; wherein if the Straws or chaffy Stalks should lie in a confused heap, they would be subject to be prickt by the sharp ends of them; whereupon they turn them up and down, till all the said sharp ends be laid smooth, and their decumbiture be softened and made easie. Which we only seeing done, and comparing the Production thereof with the Method which we our selves should use in an exercise of the like actions, may possibly allow this disposition of Chaff Stalk to be prudent and directed by Reason. But whereas it proceeds from Birds themselves, it is no other than a frequent turning this way and that, of Bodies which offend the Sense, till such time as they bring no further pain or trouble with them. As to the dawbing over their Nest with Mud, it may be ascribed to the vehement heat which predominates at that time of the Year; for hence it comes to pass, that they delight to be conversant in Mud, Water and Sand, without which all Birds would quickly sicken and be deprived, first of sight and then of Life; but the same Mud, which, because it refrigerates or cools, they carry to their Nest in their Bills and Feet; the same, I say, when it begins to grow hard and troublesome, they wipe off, and making a hole through in the place where they rest, they fly out to get that which is fresh and cool.

LIII.
Those Birds
are not led
by prudence,
which re-
move from
one Region
to another.

As to those Birds, which upon the approach of Winter, remove from one Region to another. It is not to be ascribed to their Prudence or Providence, but to their Natural Inclination, by which they are easily impelled to remove from a colder to a warmer place, into which afterwards the same temperament succeeding anew, they return again, provided the said Regions be not very far distant from each other, and not uneasy in access; otherwise I am apt to believe that the said Birds would betake themselves into certain hiding Holes like Dormice, Serpents and Insects, and there lie dormant all the Winter, which might be proved by many instances, but it will be sufficient to mention the Swallows, which in the congealed Lakes of Poland, lie all the Winter time unmoved, and as it were, dead; but the returning heat dissipating the Frost, and the Ice dissolving into Water, they rise out of their Lakes, and betake themselves anew to their flight. Which when that Possennus, who went Embas-

sador into Russia, as Gassendus mentions, would not give credit to, a great flake of Ice was commanded to be brought into his Stove, in which a cluster of Swallows lay crouded together; which when the Ice began to melt by the heat of the place, were observed by degrees to move Feet, Wings, Head, and then the whole Body; lastly to fly out; but after some rounds of flight about the Stove, they fell down dead upon the ground, as having undergone too hasty and unwonted a change of Air. Much of the same nature is what hath been observed of other Birds, particularly in Germany, in Oaks and other hollow Trees, when cut down, Kites and Cuckows are found to have hid themselves there all the Winter. Something like to this may be also thought of the Storks, since it is yet undiscovered whence they come, and whither they betake themselves. Whence PLINY in his First Book, Chap. 23. No Man discerns when they depart, tho' it is apparent that they do go; nor knows when they come, tho' we find that they do come. Both doubtless, i. e. their coming and going is done in the Night time; and tho' they are commonly seen to fly to and fro, yet they are thought never to make their first approach but by Night. From which words it plainly appears, that the Storks come not from any far Region, nor go from us into any very remote parts, but so keep their way along the Ponds and Lakes, that neither their ingress nor egress can well be observ'd by us.

Lastly, As to Beasts seeming to foreknow some things, we need not for this ascribe to them any thing of Divination, or acknowledge any latent Rationality in them, for the making out of these presages; since they depend only upon those mutations which happen in exterior Objects; which when Animals have received into their Bodies, they are touch'd with certain affections, which dispose them to Crowing or shaking of their Wings. For there are always in the Air some forerunners of fair Weather, Tempests, Winds, &c. which when Animals foresee, it cannot be but that certain affections must arise in those Organs which dispose to the forenamed Motions: For in the vivacity of their Senses Brutes excel Men; and as those who are depriv'd of sight, hear more quick than others; so it seems that Animals being void of Mind, and destitute of all Perception, have this recompence, that they have their Senses more acute.

LIV.
How some
Animals
seem to pre-
scent future
things.

F I N I S.



